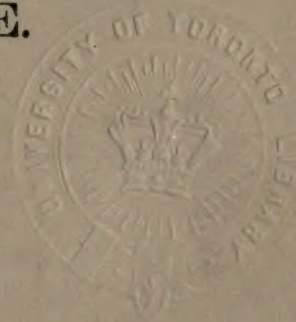


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Obituary.

PERROT.—On 26th December 1887, drowned in a tank, near Gogha, Kathiawar, James Atkinson Perrott, Assistant State Engineer of Bhavnagar, aged 28 years. Deeply regretted.

INDIAN ENGINEERING.

SATURDAY, JANUARY 7, 1888.

THE CONTROL OF OUR RAILWAYS.

NOTWITHSTANDING the assurance offered from a certain quarter that there is no foundation for the rumour that the fate of the office of the Director-General of Railways is hanging in the balance, there are not wanting indications in the official atmosphere that the subject will come up for discussion before the Government disperse for the hills in the ensuing spring. In fact, the matter could no longer be delayed without giving occasion for a serious scandal. Nobody, up to this day, knows for certain whether the individual at the head of the Indian Railway system is a tangible substance, or like the Press Commissioner a shadow of phantasm. However, the time is not far off when this point will be decided, it is to be hoped, to the satisfaction of the rate-payers. As our readers are aware, under a bureaucratic Government "notions" die very hard, and when the *fiat* of the Secretary of State doomed the existence of the Department, there was naturally a hard struggle to postpone the evil day, and obtain even a temporary respite. The sanction to prolong the continuance of the office establishment ceased on the 31st ultimo, and if matters are to remain in *statu quo* further permission must be obtained. The India Office, in this instance at least, has taken a clear and unprejudiced view of the case, and has resolved sedulously to set its face against the perpetuation of a circumlocution department, the utility of which is not appreciated by ordinary minds. They do not object to the retention of the services of the Director-General himself, as a medium of communication between the Government and the public, but they have taken exception to the unnecessarily large establishment attached to the Department, which has grown, by periodical increments, to unwieldy proportions, neither useful nor ornamental. They also recognize the fact, that the duties of the Director-General might economically be made to merge in those of the railway offices of the several Presidencies. If the growth be not checked in time, the Department runs the risk of becoming another white elephant living on the fat of the land.

In some European countries the management of railways by Government has proved a success, and produced desirable results, not only in the satisfaction rendered to the public, but also in subserving political and military purposes. In India almost the same conditions prevail, for there are few important railways which have not already been taken up by Government, though not with the happiest of results. We pay taxes, but are at a loss to know what they are expended upon. The mere privilege of submitting to the behest of a superior is not sufficient. We are therefore compelled to ask for a definite and declared policy, in an open way, as to the railway system. We have, on previous occasions, written enough on the subject to shew that a great deal remains to be done in this direction. The voice of English capitalists is drowned among the theories pro-

pounded by the India Office, and one or two opinions among Members of Council. In the wake of their opinions, follows the truism that the railways ought to be worked on the most economical and therefore the best of systems, so as to define accurately what profits are to be earned by the State and what by private enterprise. As matters stand at present, no one knows the footing of the system whether in regard to the undertakings in existence or those that are projected. In a few words, there is no settled policy as to the management of the railway lines. It is divided between Government and private companies, at the sweet will and pleasure of those who hold the control, and the result is a chaos of mismanagement where order ought to be observed. Is it therefore astonishing to find that there are conflicting interests at work, which result in a waste of public money, and are not the tax-payers justified in questioning the wisdom of such proceedings? With such facilities at hand, as the railway authorities in this have at command, it is a sorry spectacle to see the whole thing involved in such a medley. The State, the public companies, with or without any contract, Provincial Governments, and even Native States come in for a share of the management, and as a natural consequence we have the most varying conditions in fares, rates and style of working; and we need only take for instance the way in which goods are classified. It would fill columns of a comical paper at home to describe them appropriately. There is no need of caricaturing them, for all the elements of travesty are to be found there. Where does the remedy lie, but with the Director-General. At least his name so implies. And who is he? Echo answers, Who? Starting with a staff ill-adapted for the purpose it has now grown into a huge scheme, but still a reference office, the work of which might more expeditiously and with less cost be performed by the railway authorities of the presidencies. Either the office establishment under the Director-General of Railways must be recast or it should be abolished. It now remains to be seen which course the Government mean to adopt.

THE WOOL TRADE OF BENGAL.

THE supplement to a late issue of the *Calcutta Gazette* contains a note on the wool trade of Bengal, by the Director of the local Agricultural Department, Mr M. Finucane. Its argument might be fairly summed up in one line—There is no wool trade in Bengal. Mr. Finucane, from his official standpoint, puts it mildly thus:—"As regards the trade in wool produced in the plains of Bengal there is very little information available in the records of the Bengal Government, and as the Government of India has called for very early report on the subject, I have not been able to ask local officers for further information regarding it. No attempts have ever been made to improve the quantity or quality of wool produced in these provinces. The bare suggestion of the possibility of taking measures with this end in view has been made the subject of gibes and ridicule." Which being interpreted out of Secretariat language into vulgar English means that Bengal has got no wool

worth considering from a trade point of view, and that there is no trade, other than pettifogging retail trade. The sparse wool of the sheep kept, or rather left to shift for themselves, in Bengal and Behar is made up into coarse blanket, for local use, or—thrown away. This information is not to be gathered from Mr. Finucane's note. He discreetly prefers to discourse of Thibet wool. As to which we are told that the quantity of wool available for export from Thibet is believed to be enormous. But it is not exported save in infinitesimal quantities. Of Thibet, as of Bengal, it must be said:—There is no wool trade.

Apropos, here are some remarks from a report on the external trade of Bengal with Nepal, Sikkim, and Bhutan published by the Government of Bengal in 1885:—"Between Kamba and Shigatse within a march and a half of the Sikkim frontier at the head of the Lachen, sheep are killed, not for the sake of their hides or fleece, which are practically valueless for want of a market, but in order that their carcasses may be dried into jerked meat and sold for 8 annas each. At Ramba itself carpets and rugs are manufactured of the finest quality, and of patterns evincing excellent taste and skill; but there is no outlet for these fabrics. Further north on the Great Chang Thang (or northern plateau), which begins just beyond the Sanpo, within five marches of the Kongra Lama, are prodigious flocks and herds which roam at will over the endless expanse. In noticing the improvements in the supplies of wool imported into Bengal from Thibet during 1883-84, it was remarked in the report for that year—"it is believed that this trade has dwindled during the current year (1884-85), partly owing to the difficulties placed in the way by Thibetan officials," the statistics recorded shew that the belief was well founded, for the quantity imported during 1884-85 was only one-tenth that imported during 1883-84, *viz.*, 91 maunds, against 911 maunds. With the exception of 19 maunds registered at Rungeet in 1883-84, and 5 maunds in 1882-83, the entire supply during the three years was brought through Pheydong. The value of manufactured woollen goods (chiefly blankets) during 1884-85 was Rs. 4,415 in excess of the figures of 1883-84, but Rs. 564 below those of 1882-83. By far the largest supplies are brought *via* Pheydong."

Put in another form, the statistics available shew that 168 maunds of wool were imported into British territory from Sikkim and Thibet in 1882-83, 91 maunds in 1884-85, 1,933 maunds in 1886-87. Such figures do not seem to us hopeful from a wool trade point of view.

Mr. Finucane believes that, in spite of the paralysing influence of restrictions placed by Thibetan officials on the frontier trade, a considerable trade in wool *might be developed* even under existing preventive conditions by "creating a steady demand, and securing a steady sale for the article in Darjeeling." This he would effect by means of a local Government Agency. Under the circumstances it is unlikely that the most bigoted of Free Traders would object to such uncanonical interference with free trade in its guileless integrity. Assuredly, it

would be an interference undertaken solely in the interests of wholesome trade development. It appears that a merchant trading with Thibet has recently offered to deliver in Darjeeling 10,000 maunds of wool, provided that a sale thereof at Rs. 16 per maund can be guaranteed.

There anent the Director of the Bengal Agricultural Bureau goes in for arithmetic. He says :—"If the wool, as stated, can be delivered at Darjeeling at Rs. 16 a maund, or, say, three to three and a half pence per pound, and the wool is worth in England $6\frac{1}{2}$ to 7 pence per pound, as it is believed to be, there would appear to be little doubt that the existence of a steady demand at Darjeeling, or some other place nearer the frontier within British territory, would lead to a steady supply, so far as the resources of Thibet allow." The Calcutta Chamber of Commerce and the Agricultural Society are agreed that a sample of Thibetan wool sent them to report upon is worth now from $6\frac{1}{2}$ to 7 pence a pound in England, where the market price of wool is rising. Given the correctness of this estimate combined with forthcomingness of wool from Thibet in large quantities, its importation thence into India should prove a highly remunerative business.

Leaving Thibet wool for the indigenous article, we find Mr. Abbott, the Manager of the Mohunt of Jaintpore's indigo factory, quoted as an authority on sheep and wool. He says "the grazing in Behar is for India the best *par excellence*." We are glad to hear it; but where are the grazing grounds? Save in the tiger preserves of Purneah and the Nepal Terai we know of none. With a population altogether devoted to agriculture, and running to a famine pressure of 700, 800, and 900 on the square mile of country nobody is likely to find land in Behar that might be tilled given up as grazing ground, save in his mind's eye. When he talks of grazing grounds Mr. Abbott appears to mean the sides of the roads in the dry season, and indigo crops in the wet. He writes "during the rains practical farming planters are glad enough to let them (*i.e.*, sheep) have the magnificent grazing of the inevitably heavy, undergrowth in their indigo lands, charging the value of one sheep in the hundred for the right." Therefore says Mr. Abbott, because there is heavy undergrowth in indigo lands for three months in the year, "Behar is eminently a country suited to sheep farming." It is a sweetly illogical and unpractical idea. Or shall we put it that 99 Behar planters out of 100 are not "practical farmers." They certainly do not recognize heavy undergrowth as either inevitable or tolerable; and when they catch sheep "peimul kurring" their indigo—or, as Mr. Abbott puts it "grazing"—they give evidence of their partiality for the practice by sending the trespassing animals to the nearest pound.

THE Panama Canal Company, according to late advices, is pursuing the new economical policy with vigor, and expenses are being cut down on all sides. It is said that little is being done save at Culebra, La Boca and Gatun. The Machine shops at Bas Matuebin have been closed and 200 men discharged. The repair work is transferred to the Panama R. R. shops at Colon.

CANAL PLANTATIONS IN THE NORTH-WEST PROVINCES.

CANALS are useful and commendable public works when they can be deterred from efflorescences of *reh*, and do not ruin the ryots in their neighbourhood through the agency of an extortionate *amlah*. Thanks to some wrinkles in forestry acquired of late years they have become incidentally productive, as well as ornamental. We have before us the North-West Provinces Government review of the subject for 1886-87, shewing a net revenue of Rs. 98,408, a substantial increase on the in-comings of previous years.

The increase is, we are told, altogether contributed by plantations on the two large systems, while the minor canals shew a falling off.

The Agra Canal it appears is supported by a steady demand for fuel at Delhi. That is satisfactory as far as it goes; but leaves a good deal to be desired from an irrigational point of view.

It must be borne in mind, however, that canals are only intended and can only be used justifiably to eke out seasons of drought. They must always be subordinate to Railways, as famine relief agents.

In the days before Railways were, they did good service; probably no more will be constructed now; they are played out.

From a meteorological point of view, if from no other, it is satisfactory to know that the number of trees flourishing in canal plantations at the close of the year under review, made a not insignificant total. Here is the return :—

Canals.	Number of trees.		Increase.	Decrease.
	1886-87.	1885-86.		
Upper Ganges ...	796,352	795,107	1,245	...
Lower ditto ...	524,025	484,108	39,917	...
Agra ...	360,548	352,587	7,961	...
Eastern Jumna ...	243,328	248,691	...	5,363
Dun ...	13,772	12,814	958	...
Total ...	1,938,025	1,893,307	44,718	...

The following return gives the number of first-class trees, *i.e.*, trees having six feet girth and over :—

Canals.	1886-87.	1885-86.	Increase.	Decrease.
Upper Ganges ...	9,782	10,738	...	956
Lower ditto ...	7,907	7,816	91	...
Agra ...	316	277	39	...
Eastern Jumna ...	19,067	18,453	614	...
Dun ...	1,847	1,845	2	...
Total ...	38,919	39,129	...	210

The Report under consideration tells us of a marked diminution and distinguishment in maintenance charges on the Upper and Lower Ganges Canals. Why is this? Why does the revenue in the former continue to shew a marked upward tendency, while the latter does not? No exceptional economic or geographical reasons are put forward to account for the fact; but the Aligarh and Bulandshahr Divisions are invited to furnish explanations.

41,931 trees were felled during the year under review, some seven thousand more than were available in the preceding year. The highest average price was obtained in the Bulandshahr Division, the lowest in the Aligarh Division. Prices current were largely affected, we are told, by the balances remaining undisposed of in depôts at the end of the year. It occurs to us that the late Mr. Herschell Dear of Monghyr used to manage his extensive timber business on more economical lines. "It is said that sub-divisional officers in the Cawnpore Division have attempted to get a more correct count of trees this year."

What is the use of accounts unless they are correct? What is the use of sub-divisional officers if they do not always try to be correct. It would be far better to have no statistics at all, or rather no figures miscalled statistics, than misleading ones.

In the Fatehgarh District Rs. 2,003 were spent to start nurseries for raising sissoo trees, and 3,700 trees, chiefly mangoes, were planted out. That does not seem to us by any means a magnificent result. Indeed, this Report is from beginning to end disappointing; suggestive only of a lack of willingness or of ability to put a little heart into the work. The one redeeming feature is an attempt made to introduce cultivation of the date-palm into the Etawah District. Sowings there have been made with seed obtained from Burma, from the Persian Gulf, and Sind. Experiments are also being made with Tunisian seed, supplied from the Saharanpur Botanical Gardens.

About this foolish, uneconomical, impracticable attempt to graft forestry on canals, Mr. Bagshawe, of the Forest Department notes and censures, "a want of system and continuity of method." What business, whether public or private, can be carried to a successful issue without such adjuncts? It is no economy, but the very reverse to stint a department in such respects. Head masters cannot do justice to their work without help from assistant masters; Queen bees would be nowhere without qualified subordinates; a locomotive could not run without wheels. Let the Plantation Department of the N.-W. P. Irrigation Department pay more heed to the practical and less to technicalities than it has been in the habit of doing; and there will then be some hope of success attending its probably well intentioned efforts to do some good in the world.

Apropos here is a suggestive paragraph:—The system at present generally adopted is, when the budget is drawn up to make a forecast of what is to be done the following year under each head of work, while the method of carrying it out depends greatly on the time the Executive Engineers and the sub-divisional officers can give to this branch of their duties. The result is that good work done one year is often forgotten the next, and the advance made is lost.

RUSSIAN PROGRESS IN BOKHARA.—The railway station which the Russians have decided upon building at Bokhara will be completed in about six or seven months. Building materials such as iron pillars, beams, &c., are arriving from Samarkund packed on the backs of camels and horses; they are transported with great difficulty. The materials for building a bridge across the Oxus at the Karki crossing and for the construction of a caravanserai there, are also being collected.

Notes and Comments.

THE BENTOTA RAILWAY, CEYLON.—The Engineers are busy from Kalutara southwards, which means that the railway to Bentota—before that to Haputale—will shortly be *un fait accompli*. Stations might be erected at Paiyagala, Maggona and Beruwela, the terminus, for a time, of course, being at Bentota.

ALLAHABAD UNIVERSITY.—Colonel A. M. Brandreth, R.E., Principal, Thomason College, Roorkee, and Mr. J. S. Beresford, M.E., Officiating Superintending Engineer, 1st Circle, Irrigation Works, have been appointed to be Fellows of the Allahabad University. Will Roorkee be affiliated to the new University?

RAILWAY ENTERPRISE IN INDIA.—A Consulting Engineer for Railways declares anent a proposal for a small provincial line offering as favorable prospects of remunerative return as any line in the country, that "any idea of raising the capital in this country may be dismissed as being in the highest degree improbable."

WATER-SUPPLY SCHEMES IN THE NORTHERN CIRCARS.—Both Vizianagram and Vizagapatam are to have water projects. The failure of artesian borings in the latter town renders such a measure imperative. The work in both cases will be entrusted to Messrs. Burn & Co. of Howrah, who are already well known in the district.

BOAT NAVIGATION ON THE MADRAS CANALS.—It has been elicited that although the authorised charge from Masulipatam to Bezvada, 48 miles, is 8 annas, yet that passengers are often carried for 1 anna, owing to boats competing one with the other. Under these circumstances, the public can travel at quarter pie per mile, which is the cheapest fare on record in this or any other country.

THE "LUCIGEN" AGAIN.—It may be remembered by our readers that some weeks ago an experiment was made in Bombay with the Lucigen apparatus, which is designed to afford a bright light in open spaces, the flame being produced by oil and the machine being wrought by means of compressed air. This new illuminant has been made the subject of an elaborate paper and exhaustive discussion before the Society of Arts, London.

THE NIZAM'S P. W. D. GRADATION LIST.—Mr. Palmer, the Chief Engineer and Secretary of the Hyderabad State P. W. D., has graded the Executive Staff working under him, and promotions will henceforth depend on the rank in the Graded List. There is much dissatisfaction among some of the officers—especially the Assistant Engineers and Supervisors who passed from the late C. E. College—with regard to the order in the List.

BOMBAY PORT TRUST.—Prince's Dock Extension Works Progress Report No. 35 for November 1887 shows that certificate No. 34 for Rs. 59,557-1-1 was passed on the 12th December, the total amount paid to the contractors to date being Rs. 38,96,892-2-4. The daily average number of men and women working on the Dock and at the quarries for Messrs. Kirby & Co. was 2,426, the greatest number in one day (8th November) being 2,724.

"OURSELVES."—A leading Madras paper says: "INDIAN ENGINEERING, an illustrated weekly journal published in Calcutta in the interest of the Civil Engineering Profession in India, commences its second year of publication on the 1st of January. Mr. Pat. Doyle, C.E., the Editor, through whose enterprise INDIAN ENGINEERING was started and brought to its present perfection, is to be congratulated upon the success of his labours. The circulation has attained to over one thousand copies per week."

THE LATE MR. FRANCIS FEDDEN, F.G.S., A.R.S.M.—The Director of the Geological Survey of India has received telegraphic information from the Collector of Vizagapatam of the sudden death from heart disease of Mr. Fedden, Officiating Superintendent, who joined the Survey in 1860, and had attained to the rank of First Grade only in April last. Mr. Fedden was known as a most conscientious and hardworking officer, from whom much was expected, relative to a part of the country which had up till now only been cursorily examined by the Survey.

A P. W. D. GRIEVANCE.—The members of the upper subordinate establishment of the Public Works Department were "gazetted" officers from the time of the establishment of the Department, but they were afterwards deprived of that privilege which they held for years. It is not consistent with reason or justice that a sub-inspector of schools on Rs. 30 a month, or an educational clerk on the same pay, should have his appointment gazetted, while a sub-engineer on a pay of Rs. 500 and an allowance of Rs. 150—in all Rs. 650—a month, is not a gazetted officer.

NERINJIPET PROJECT, SALEM AND COIMBATORE DISTRICTS, MADRAS.—The Executive Engineer's report, having quite satisfied the Superintending Engineer that it would be a waste of time and money to proceed further with the investigation of the project, as it could not fail to be utterly unproductive, while even famine works are expected to promise some small returns, it has been decided by the Chief Engineer that the further investigation of the Nerinjipet project in the Coimbatore and Salem districts may be abandoned, and it will be excluded from the list of those projects requiring investigation.

STAR OF INDIA.—*To be Knight Commander:* Colonel James Browne, C.B., C.S.I., Royal Engineers, lately Engineer-in-Chief of the Sind-Pishin Railway. *To be Companion:* Francis Langford O'Callaghan, Esq., C.I.E. Engineer-in-Chief of the Sind-Pishin and Kwaja-Amran Railway. Referring to these honors, we find the observation made that Colonel Browne is a suitable addition to the list of Knights Commanders, and that Mr. O'Callaghan—the ablest of our Railway Engineers—deserved better than he has received, comparing his services and his reward with those of others whose names appear in the *Gazette*. Both nominations are, however, a welcome recognition of the claims of the Profession.

PUNJAB FORESTS, 1886-87.—The financial results of the year's working have been satisfactory. The net surplus was Rs. 4,10,767 as compared with Rs. 1,74,936 for the previous year. The receipts were Rs. 11,27,277, an increase of Rs. 2,76,858. The expenditure amounted to Rs. 7,16,510, an increase of Rs. 41,027 only. The increase in the revenue is due to extended timber works, principally in Chamba, Bashahr and Pangri, to the disposal of Kulu sleepers and to increased sales of fuel to the Railway Department in the Chenab and Montgomery Divisions. The amount of outstanding revenue at the close of the year, Rs. 65,970, is large. This is chiefly on account of grazing revenue in the Gujranwala District and the Montgomery Division, where distress prevailed among cattle-owners.

RUSSIAN PROGRESS IN CENTRAL ASIA.—Until the other day no bridge had spanned the Oxus since the time of Timur the Tartar. On the 19th of October, General Annenkoff rode across the new Railway bridge, which is near enough to completion to allow of the passage of a man on horseback. Timur's bridge was a bridge of boats and is described by the honorable knight, Ruy Gonzales

de Clavijo, who was sent by the King of Castille on an embassy to the city which Milton knew of as "Samarcand by Oxus, Temir's throne." That was nearly five centuries ago. Moscow, which, as Gibbon says, once trembled at the approach of the Tartar, is already master of Samarcand; and the construction of the Russian Railway bridge over the Oxus at Charjui is only the prelude to a formal annexation of Bokhara.

STATE RAILWAYS IN CEYLON.—The fact that during the last 20 years the extension of the Railway system has been an almost continuous source of bitter controversy about gauges, routes, engineering questions and other such matters which, in other countries, are never heard of outside of Engineers' offices and Railway Board rooms, is a remarkable feature of Colombo local history. The strange spectacle of a community divided by such questions into parties, disputing their several opinions even more fiercely than is done by experts themselves, suggests that there must be some special peculiarity in the position to account for wrangling, such as never disturbs the public mind elsewhere. To say the least, Railway matters in Ceylon must be sadly out of joint, and we can only account for it by the false position in which the Government stands in relation to the question.

MADRAS TANK RESTORATION WORKS.—The total area covered by these operations of 1886-87 was 8,082 square miles, of which 5,485 had been completely investigated at the end of that year. The amount of estimates sanctioned during the year was Rs. 3,64,236, the cost of investigation being Rs. 2,17,506, or 59.7 per cent. of amount of estimates. This is a rather higher percentage. The total amount of estimates sanctioned from the commencement of operations in 1883-84 up to the end of 1886-87 was Rs. 9,28,137, of which Rs. 8,19,871 are for Government tanks, and Rs. 1,08,266 for zemindari and private tanks. The total expenditure to the end of 1886-87 on Government tanks is Rs. 3,88,534, and a balance of sanctioned estimates for Government tanks, amounting to Rs. 4,30,337, therefore remained on 1st April 1887 to meet the allotment of Rs. 2,58,024 on "works" for 1887-88.

DEFICIENT RAILWAY PLANT.—The *Civil and Military Gazette* writes:—"Burma is suffering from an unnecessary attack of officialism, a remarkable instance of which is recorded by a Rangoon contemporary. So long ago as January last, a contract with the India Office authorities was entered upon for the supply of a certain number of 50lb. rails for the Toungoo-Mandalay Railway. They accordingly turned up, and were duly shunted off to their destination, where everything was ready for their reception. When the plate-layers started work, however, the rails were found to be minus fish-plates, bolts and spikes. This of course meant a delay of another three months, because the new rules relating to the Store Department requires that all plant and material shall be supplied direct from London. Evidently the good folks at Whitehall need a little waking-up."

ASSAM RAILWAYS AND TRADING COMPANY.—The Secretary of the Assam Railways and Trading Company, Limited and Reduced, has issued a circular stating that the Company has entered into an agreement with the Rivers Steam Navigation Company, under which the Rivers Company take over the flotilla of the Company with the exception only of one small steamer and two of the smaller flats which are required for Railway purposes. The agreement further assures to the Assam Railways and Trading Company the sale at remunerative prices of coal to

an extent much in excess of the sales hitherto existing. Moreover, under the agreement not only will carriage be provided, at reasonable rates, for nearly all the coal which the present capacity of the collieries and Railway can conveniently deliver, but arrangements are also made for its sale upon terms likely to be remunerative to this Company. The general effect of the agreement is such as marks a new departure in the affairs of the Company, which very materially improves its prospects.

THE MYSORE WATER-SUPPLY.—A Bangalore paper observes that while numberless minutes have been written and endless discussions have taken place to improve the water-supply of Bangalore, it is a patent fact, notwithstanding, that nothing effectual has yet been done. The city of Mysore, however, has taken a step in advance, thanks to the liberality of the Durbar and to the activity of Mr. Standish Lee. The main portions of the capital have now a very good supply of the precious liquid brought down by pipes laid from the large Kooker-halli tank, which can be drawn by people from elegantly set fountains erected at different localities. Another convenient management which one notices is that clean and handsome stone reservoirs have been formed, in which limpid water is stored up. These nice little artificial ponds are kept scrupulously clean, one being set apart for the Brahman community, another for the Moslem brotherhood, and the third for the Soodra population. We learn that by degrees, the whole of the town and its suburbs will be similarly supplied with fountains.

OBITUARY.—Mr. Francis Fedden, A. R. S. M., F. G. S., Officiating Superintendent of the Geological Survey of India, whose death we have noticed elsewhere, was a distinguished student of the Royal School of Mines, London. He joined the Survey in 1860, when he was deputed to Burma until 1864, and was then attached to the Salween surveying expedition. During the rest of his career he worked in Central India and the Bombay Presidency until last year, when he was moved down to Vizagapatam. One of the great generalizations of the Survey as put forth by Mr. H. F. Blanford was the glacial character of the oldest (Talcir) group in the Gondwana formation (coal bearing series), but to Mr. Fedden is due the discovery of the complete evidence of this in the scratched boulders and old floor of that group in the Central Provinces; a large boulder standing now in the Geological Gallery of the Indian Museum bearing witness to his singular closeness of observation.—Part 2 of Vol. XXI of *Memoirs of the Geological Survey of India*, "Geology of Kathiawar," is the result of his independent work on that side of India.

SOME CHARACTERISTICS OF THE NATIVES OF INDIA.—Mr. James Young, the Honorary Secretary of the Sassoon Mechanics' Institute, on a recent occasion lecturing on the above subject said:—A country so beautiful as India ought to have produced a splendid national school of art; but, strange to say, no such school exists, and the study of art possesses no charm for the native mind. Art has achieved her triumphs where she has had the greatest difficulties to encounter. In India the vivid colorings of nature are appreciated by the stranger alone. The native beholds the sun rise and set in transcendent beauty, but gazes on the spectacle with indifference. The tropical glories of the night, the full-orbed moon and the eloquent stars excite no feeling of admiration in him. Amidst scenery of unrivalled beauty, he pursues the even tenor of his way, deaf to the appealing voice of nature. Efforts are now being made by the administration to stimulate and

foster a love of the beautiful, and to promote the cultivation of art among the native populations. Those efforts are directed towards a truly praiseworthy end.

THE CINCHONA INDUSTRY IN INDIA.—In spite of a landslip last year by which 300,000 promising trees were launched into space, the cinchona plantations at Darjeeling continue to increase and multiply, and shew a balance on the right side of the books. Last year the initial cost price of the stuff and the outlay incurred in its preparation was Rs. 94,028 and the value of the febrifuge produced Rs. 1,13,152. Harvesting the bark cost a fraction over 5½ annas per pound at Darjeeling. On the Nilgiri plantations it costs nearly 11 annas. Sales of the febrifuge to medical departments and the public from Darjeeling amounted to 5,885 lbs. last year. This represents a slight increase over the previous year's returns, but measures short when compared with the demand between the years 1881 to 1884. One of the causes of this is said to have been that the Medical Department had to work off large stocks of English quinine sent to India by the Secretary of State four years ago. It is the Secretary of State's irresponsible privilege, in small matters as well as in great ones, always to be doing those things which he ought not to do.

STATE AGENCY FOR RAILWAY MANAGEMENT.—*Apropos* of late miscarriages and complaints of inefficiency and muddle on the part of the management of the Eastern Bengal Railway, a contemporary pertinently suggests that a Railway Manager ought to be trained up to his business, and that it does not pay the State any more than it suits public convenience to pitchfork square men into round holes, or *vice versa*, without regard to their fitness for the work required of them. "He should be conversant with every method of fostering the use of the line for the transport of country produce, and not kill it by leaving merchants to convey, as in the case of jute, their merchandize by country craft to Chittagong for shipment." Surely this is a matter the Calcutta Chamber of Commerce might bestir itself about. There will be a good opportunity soon, when the Government of India returns to its head-quarters. When Mr. Franklin Prestage was Manager of the Eastern Bengal line its affairs were conducted to everybody's satisfaction, recipients of dividends on shares not excepted. And now in connection with it one hears of nothing but muddle, inconvenience, and bickerings between the travelling public and *insouciant* State Railway officials.

THE MEINAM FLOTILLA Co., LIMITED.—There was recently launched from the building yard of the Bangkok Dock Company, Limited, the first steamer of the recently formed Meinam Flotilla Co., Limited, for which the Borneo Company are the Managing Agents in Bangkok. The Company has been formed to build vessels for the purpose of opening up trade with the interior of Siam, and is intended to be worked on similar principles as the Irrawaddy Flotilla Co. of Burma. The vessel is of the flat-bottomed stern wheel type, to suit the shallow parts of the river, and was designed and built in Port Glasgow by Messrs. D. J. Dunlop & Co. She was shipped out in pieces, and rebuilt by the Bangkok Dock Co., Limited. Length over all 108 feet, beam 24 feet 6 inches, depth 4 feet. She is built of $\frac{3}{8}$ " galvanized steel, in several compartments, well stayed and supported throughout by struts and bulkheads. The decks, passenger cabins, &c.,

are of teak, made and fitted by the Bangkok Dock Co. Her engines are composite, diameter of cylinder 17, and 34 stroke, situated right aft, while the boiler is of the locomotive type and placed forward; the wheel is composed entirely of steel, and is 11'6" diameter. The Company has now commenced building steel barges, and it is expected another steamer will soon be under way.

METEOROLOGY IN BENGAL.—Mr. Pedlar says in his Summary of the Monsoon period of 1887, that the main features of interest in the meteorology of the period antecedent to the rains appear to have been, first the occurrence of the heavy snowfall in the Himalayan region to the north of Bengal. It is apparently now established that an unusual accumulation of snow in the Himalayas tends to retard the advance of the south-west monsoon humid current over Upper India, and hence to diminish considerably the rainfall of the south-west monsoon season. Thus the existence of this condition rendered it possible, or even probable, that the monsoon current in 1887 would not establish itself in Bengal till rather later than usual, and that it would be rather feeble, and, as a matter of fact, the current did not establish itself till a week later than the average date of commencement; throughout its existence it was weak, and finally it retired considerably earlier than usual. The second point of interest was that temperature had generally been decidedly below the normal (possibly also caused by the heavy snowfall in the Himalayas), and for certainly three or nearly four months out of the five, the mean temperature was distinctly in defect. Pressure had also been in defect, but not quite to the same extent, while on the other hand the rainfall of three or four out of the five months had been decidedly larger than the normal.

"MADRAS RAILWAY" EXTENSION.—The following particulars in connection with the Palghat and Calicut Extensions of the Madras Railway, to be opened for traffic with the new year, cannot but be of interest to our readers. The Palghat Extension is only 3 miles long. It starts with a curve of 20 chains radius from the present Palghat station—which for the future is to be designated Olavakod—runs in a north-easterly direction to the town itself of that name—where the station arrangements for the present are temporary, pending the decision upon the proposed extension from Palghat to Dindigul. Besides a single twenty-foot girder, opening at the 332nd mile, the only work of importance, is a girder bridge of four sixty-foot spans over a branch of the Ponani River. The Calicut Extension is 9 miles long, and diverges from the main line at the 364th mile, the line between this point and Beypore being, for the present, still reserved to work the goods traffic to Beypore, pending the completion of the Ferok Bridge; but this will be ultimately abandoned. There are three large bridges on this portion of line, one of four 64 feet openings over the Beypore backwater, which is incomplete (Ferok Bridge), and across which, for the present, passengers and goods will be ferried; one of six 121 feet spans over the Beypore River, which, being also incomplete, is supplemented by a diversion across the bed of the river, and one of three 21 feet spans over the Kullai River, which has been completed.

A BRAHMIN B.A., B.C.E.—The following story is told by Lord Connemara, Governor of Madras, in an account His Lordship has published of a tour through Wynaad, Malabar, Cochin, Travancore, Tinnevely, Madura, Trichinopoly and Tanjore:—"A Brahmin surveyor, a Bachelor of Arts and of Civil Engineering, employed in these

works (Peryia Canal project), has been living in terror of wild beasts ever since he arrived there. He hears elephants 'growling all night, which sends his heart down to zero point of courage.' He has, he says, been 'chased by a blue-eyed bison,' and flying 'with great velocity' dropped his theodolite. The instrument broke, and he tried to replace the cobweb with one of his own hairs—a wire cable to a silver thread. When remonstrated with, he said, he dropped the theodolite, in order to save life (his own). On another occasion, he fell down a precipice, and 'would have been killed, had not gravity come to his aid.' Nor is this the full tale of his adventures. One day, while carrying a big stick, he met a bear, or thought he did, and fled, leaving all his work-people to face the animal. The Executive Engineer told him he should not have left his men; but he explained that on seeing the bear he 'immediately made a mental calculation of his stick's powers of resistance by Hodgkinson's Tables,' and found them insufficient. As for the work-people, he left them 'because they could not run as fast as he could.' His brother actually did get into trouble one day, and this Bachelor of Arts and Engineer thanked God it was his brother and not himself, 'because he drew less pay, and would consequently be less missed by the family.' Altogether he is a source of much amusement, and hopes great things for himself, saying that since he came up he has already been made 'half a man.' It is quite a new thing for a young and educated Brahmin, the heir of all the (Hindu) ages, to take to jungle work at all."

JOINT STOCK COMPANIES IN INDIA.—The amount of capital invested in Joint Stock Companies in this country is much larger than many persons might imagine. At the end of 1886-87 there were no fewer than 886 Companies, possessing a nominal capital aggregating 2,913 lakhs, and an actual paid-up capital of 2,138 lakhs. Out of the total capital Bengal heads the list with 968 lakhs, Bombay follows with 872 lakhs, and Madras comes third, with 144 lakhs; so that these three represent about 92½ per cent. of the whole invested capital. Trading Companies, which include merchants and traders, navigation, railways and tramways, co-operative associations, and shipping, landing and warehousing Companies, have a paid-up capital of Rs. 3,16,24,027. Under the heading of mills and presses there are 53 cotton mills, 10 jute mills, 38 mills for cotton jute, wool, hemp, &c., 60 for cotton and jute screws and presses, and 29 other mills and presses, the total paid-up capital being Rs. 9,10,68,956. For mining and quarrying there are 25 Companies, with a paid-up capital of Rs. 98,47,314. Ice manufacture is represented by 12 Companies, with Rs. 20,96,313 paid-up. There are only two sugar manufacturing Companies, but these have a paid-up capital of Rs. 16,09,425. There are three breweries with a fully paid-up capital of Rs. 12,00,000. As may be seen, the largest part of the capital is invested in mills and presses, where Bombay heads the list, with 619 lakhs, chiefly for cotton or pressing cotton, while Bengal comes next with 196 lakhs, chiefly invested in jute mills and presses. The trading Companies are nearly equally divided between Bombay and Bengal, the former having 147 lakhs and the latter 141 lakhs invested in these Companies. Bengal again heads the list in the mining and quarrying Companies, with 78 lakhs, only 10 lakhs being invested in the much-talked of gold mining Companies in Madras. The ice making Companies are chiefly confined to Bengal and Bombay, while the breweries are all in the Panjab and the North-West Provinces and Oudh.

Current News.

The first sod of the projected Dhoraji-Porebunder Railway was turned on 29th December.

CAPTAIN J. H. MEIN, R.E., Executive Engineer, Barrackpore, has been transferred to Jubbulpore.

A TOTAL of £4,000,000 sterling is the expenditure needed to link Upper Burma with both Chittagong and Calcutta.

LORD REAY opened the branch line from Jetalsar to Choki on 30th December. The Governor recommended the further extension of Railway in Kathiawar.

The sittings of the Bengal Irrigation Commission were suspended during the Xmas holidays. They recommenced work this week, as the inquiry is far from complete.

Information has been received that the portion of line to Bezwaia of the Bellary-Kistna State Railway is to be transferred on 1st proximo to the Southern Mahratta Railway.

The survey party to the Hukong Valley will set out after all, the difficulties in its way having been arranged. It may be expected to reach the Chindwin River by the 30th of January.

SATISFACTORY reports continue to be received from our Afghan Boundary Commissioner, who is now well on his way to the Oxus, to complete the Dukchi-Bosaga line of demarcation.

The working of traffic by natives on the several Railways on which they are employed in India is on the whole favourably reported on, in the Administration Report just published for 1886-87.

WE regret to learn that Mr. Francis Fedden, A.R.S.M., F.G.S., first grade Deputy Superintendent of the Indian Geological Survey, died suddenly at Vizagapatam of heart disease on the 27th instant.

At the instance of the Secretary of State, the various Boards of Direction of the Guaranteed Railway Companies in India have consented to adopt the State Rules on their lines in regard to the acceptance of testimonials or valedictory addresses by Railway employees.

MOXOHTA, a well-known town in Bengal, has always been noted for its fabrics, but it is becoming celebrated for the manufacture of firearms. The total number of muzzle loading guns turned out last year was 2,631 of which as many as 2,253 were exported chiefly to Calcutta.

The construction of the Frontier Railway extension between Hurokh and the Kotal is in hand, and is being pushed forward rapidly. The Swiss Engineers brought out especially for the ghaut work, on which section the Abt system is adopted, hope to get through it in six months.

The financial prospects of the Barragunda Copper Company show that the liabilities were Rs. 33,000, while the assets in copper and cash were Rs. 32,000, with a call due in March, which would bring in about Rs. 1,37,000. The monthly expenditure was about Rs. 15,000, of which Rs. 5,000 came from block.

MR. H. W. CLIFF, Executive Engineer, has been sent to the Central Provinces to make a reconnaissance survey from the neighbourhood of Rajnandgaon on the Bengal Northern Railway to Warunga, in Hyderabad. This is the first step towards the direct line of Railway from Calcutta to Madras.

The Chief Commissioner, Central Provinces, has ordered the road from Nagpur to Umrair and Bewapur to be roughly surveyed and reported on, with a view to constructing a light railway to those places, if the traffic is likely to be good. Mr. D. Wallace, Executive Engineer, is engaged in the work.

The native Municipal Commissioners of Calcutta continue to oppose the scheme for constructing a wide street from the Howrah bridge to Sealdah. The part of the town which the street would open up and let light and air into is typically Asiatic, and a reproach to a civilized Government. But under the fully called Local Self-Government, the Government of India is not responsible for it.

The utility of Mangalore tiles is so well recognized now that the Mysore Government are liberally using them for all their public buildings, as well as for inspection lodges, travellers' bungalows, &c. in the province. The manufacture of these tiles has been taken up by certain natives here who have learnt the work at the Mangalore German Mission tile-works. As the trade in the sale of the tiles is increasing, steps are being taken by them to erect more spacious premises for the manufacture.

A MEETING was held lately at Cuttack, at which the Uncovered Service in Orissa was fairly represented, and the resolutions passed at the occasion were frank and outspoken. The men of Orissa have agreed to act in concert with Mr. H. S. King's Committee and to use funds to aid that body. They would impress on the representative Committee as strongly as possible that they were not complaining of their salaries *alone in India*, but about the *leave and pension allowances while out of India*.

The Report and Accounts of the New Beerbhoom Coal Company, for the half year ended 31st October 1887, have been duly

circulated to the Proprietors. The net profit on working the Collieries for the period under notice amounts to Rs. 59,138-9-6 including Rs. 3,826-3-6 the balance brought forward from previous half-year, and this sum the Directors recommend should be disposed of by paying a dividend of Rs. 6 per share being at the rate of 12 per cent. per annum, and meeting other charges.

For a long time the want of a bridge over the Cauvery on the Siddapur-Mercara Road, Coorg, was keenly felt. The bridge now erected is of seven spans, and built throughout of stone. The design was prepared by Mr. Sharp, under the check of Colonel LeMessurier, when the latter was the Superintending Engineer of Coorg P. W. D. Though the parapet of the bridge has not yet been finally touched up ornamentally, yet the structure is substantial and highly useful for intercommunication between Siddapur and Mercara. Other bridges are still required in different places in Coorg, and where they are not supplied ferry boats are plying, and communication from one side to another is necessarily slow.

The shipbuilding industry of Chittagong, which not many years ago was considerable, is quite unable to contend against the various adverse influences which affect it, and it certainly seems that instead of participating in the revival of trade,—now becoming general—it is doomed to extinction. Rice shippers, and other importers, and exporters, prefer European vessels to the country craft; and competition has reduced the freights of country brigs for jute cargoes, &c., so low, that there is nothing to induce capitalists to invest in the construction of new vessels. As in the previous year, only two vessels were built in 1886-87; and we are informed that things have not improved this year, but on the contrary are even worse.

THE Forestry Committee, appointed in 1885, has recently submitted its report. The purpose of its appointment was to consider whether, by the establishment of a Forest School, or otherwise, our woodlands could be rendered more remunerative. The report, which has been published as a public paper by order of the House of Commons, shows that the Committee has especially directed its attention to the questions how far there is need of some means of giving instruction to those engaged in the cultivation and management of woodlands; how far the establishment of a school, or schools, of forestry would meet such need; whether a board of persons, representing various interests and associations connected with agriculture, arboriculture and silviculture should be formed with the assistance of Parliament, for the purpose of examination, granting certificates and generally promoting the improvement of our woodlands; and whether by either or both of such means the cultivation of woodlands could be made more remunerative.

Letters to the Editor.

[The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

PUNKAHS.

SIR,—With reference to Mr. Bull's letter in your issue of 24th December, allow me to express my regret that I did not know or find out that the system I have used, and advocated the use of, was a patent. I will communicate with Mr. Bull direct, should he desire it.

M. B.

A GRIEVANCE.

SIR,—In renewing my subscription I cannot help remembering how loud you have blown the trumpet of Cooper's Hill, as though all C. H. men were necessarily *perfect*, and there were no *bad* bargains from Cooper's Hill. In order to enable the public to judge of the worth of your utterances, you ought to let us know whether you and the majority of your subscribers are from Cooper's Hill. India has had to pay dearly for the bad bargains, both R. E. and C. H. At the same time I don't like Roorkee and Seebpore men.

A SUB OF 18 YEARS.

[Our Correspondent is evidently difficult to please, and our only object in inserting his letter is to once more repudiate the idea of our belonging to any party.—ED., I. E.]

ROYAL ENGINEER NEWS.

SIR,—The paragraph at page 408 of your Journal for 24th December relative to the *supposed* supersession of Colonel Cumberland C.B., R.E., by Major-General Edwards C.B., R.E., is entirely incorrect.

Promotion to the rank of General Officer is always regulated by Army, not Corps, seniority.

Both these officers reached the rank of full Colonel on 1st October 1877, but Major-General Edwards became a Lieutenant-Colonel on 11th April 1871, whilst Colonel Cumberland only reached that rank on 1st June 1873.

The former was therefore the senior *in the Army*.

Colonel Cumberland's longer service of 5 years *in the Corps* in no way affects the question.

So far from this being an isolated instance, it is constantly happening!

It *must* happen, whenever an officer, who has had his promotion accelerated by Brevets reaches the top of the full Colonels in order of Army seniority.

LAHORE; December 26, 1887.

E. HARVEY, Lieut.-Col., R.E.

Literary Notices.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.

PART 4 of volume XXXVI. for 1887, gives the Proceedings of the annual Meeting held in connection with the Royal Mining, Engineering and Industrial Exhibition at Newcastle-upon-Tyne, when in addition to members, there were also present a large number of mining and mechanical engineers from all parts of the Kingdom and the Continent, who had visited Newcastle and district on 3rd, 4th, 5th, and 6th August, at the invitation of the Institute.

The President's Address is in every way worthy of the world-wide eminence of Sir Lowthian Bell, and contains matter not only of interest for the moment, but suggestive for the future.

The Secretary's Paper on "The Federation of the Mining Institutes of Great Britain," deals with a subject of "Imperial" importance, using most powerful arguments in favor of a Central Society of sufficient power and influence to make it the interest of every Mining Engineer to belong to it.

ROYAL STATISTICAL SOCIETY.

THE Journal for September contains an excellent article called the "Statistical Story of the Suez Canal" by Mr. Joseph Rabino. The subject is treated from the standpoints of (1) Political, (2) Historical, (3) Technical, (4) Financial, (5) Commercial. In the Discussion, Sir John Stokes, K.C.B., thought the Paper contained an admirable *exposé* of the past history of the canal, of its inception, the difficulties encountered, and the mode in which the work was carried out. He thought that the Society was to be congratulated on having had before them the most complete paper of reference with regard to the Suez Canal that had come under his purview. This is saying a great deal, but not a bit too much, we think.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

THE July Number of the Transactions for 1887 is rather late to hand. The President's Address at the Annual Convention gives some particulars regarding the constitution and composition of the body over which he presides. He asks: Whence are we to draw our future membership to maintain the ranks of our Society? In answer a distinguished Professor and Engineer furnished him with the following statistics: "There are in the United States 360 colleges and universities, which, besides classical and other courses, teach technology, and have given diplomas on technical professional subjects to 1,058 graduates. There are besides 49 schools, working under the 'Land Grant,' with 593 teachers and 4,644 students, of whom about 600 were technical graduates. In addition to these there are 39 private technical institutions with nearly 300 teachers and over 7,000 students, 800 of whom received technical diplomas. Statistics of this kind are very difficult to obtain, but it may be said that our higher schools of science turn out about 25,000 men per year, and of these about seven per cent. are engineers." Hence it becomes necessary for those who are conversant with the needs of the profession, to advise, that before entering technological institutes, students should have a good school training, such as is required in entering classical universities, and that within the institutes they shall know not only what to learn, but also how to learn. Then in their outer world progress they may know how to accumulate knowledge useful to themselves in their profession, and reciprocate for the information and pleasure of those with whom they are thrown in contact.

President Worthen is both original and sentimental in his concluding remarks, when he says: "In the earlier part of my address I claimed for the origin of our name, Engineer, *le génie*—genius; but genius, inborn, is derived from the Greek *gune*, woman, and I trust that there is no profession which has a higher respect or greater love for that name than our profession, whether as mother, sister, wife, or companion in the halcyon

days of youth, or, in maturer years, our origin, protection, comfort, and inspiration. We trust that they will always attend our annual outings, intended not only for interchange of views in matters of our profession, but also as a relief from business, a union for the establishment of a more general acquaintance, and cementing the bonds between the members of the American Society of Civil Engineers."

Mr. Swain's Paper on the Calculation of the Stresses in Bridges for the Actual Concentrated Loads, has for its object the investigation of the stresses due to systems of actual loads, and the discussion of the simplest methods of finding such stresses, with the corresponding positions of the system of loads.

ROYAL METEOROLOGICAL SOCIETY.

THE Quarterly Journal for July 1887 contains three Papers on the subject of Wind Measurement. The Report of the Wind Force Committee consists principally of a comparison of wind force as estimated by Beaufort's scale at different Lightships with the velocities measured at adjacent Anemographs. There is, to a certain extent, agreement in the results, with also some discordance, and on the whole the Committee felt unable to determine with any certainty the velocities corresponding to the numbers of Beaufort's scale, neither were they able to recommend any existing scale. Credit is due to Mr. Chatterton for the great trouble he has taken in carrying out the comparisons for the Committee, and for his proposition of the draft of Report. Of Mr. Dines's Anemometer, which forms the subject of the second Paper, it may be said that anyone having the necessary time and skill, who will turn his attention to the question of the improvement of anemometers, will deserve the best thanks of Meteorologists. Simplicity of construction is a thing to be desired, but actual work will, after all, best test the capabilities of an instrument. Of Mr. Whipple's two instruments, the description of which makes up the third Paper, it can only be remarked that we should somewhat fear whether the little discs could practically be relied on when there was much wind.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.

THE first issue of the "Transactions" for the 31st Session, 1887-88, contains the usual Inaugural address, in which President Kirk gives an admirable *résumé* of the wonderful events through Engineering invention, and progress, on a very large scale, in many different ways during the past fifty years. Mr. Carlyle Wallace's Paper on the Indicator as applied to modern Steam Machinery is with the purpose to shew that Engineers are fully alive to the imperfections of Richards' indicator for high speeds, at least to consider what has been done by them and makers of indicators up to the present time towards getting rid of these faults by the production of more reliable instruments, and to point out in a general way the direction in which, in the author's opinion, improvements may still be made.

The bound volume of the Transactions for the past Session, 1886-87, containing many of the Papers already noticed by us is a valuable record of mechanical science and practice, alike useful and interesting to the profession at large.

A Java paper is assured by a correspondent that the most effective way to keep the ground floors of dwellings and store houses dry is, when building, to spread over the spot a layer of fine coal dust stamped compactly. A layer of sand of equal thickness is then laid over it, and upon that the floor. When so constructed, the floor will, it is said, always remain dry from the coal dust absorbing the moisture of the soil. The sand layer and hence the floor are secured from dampness and continue dry. To keep away white-ants, the laying of a layer of coal dust under ground floors, has proved highly serviceable owing to the inability of these destructive insects to make their way through it.

ACCORDING to experiment, the tensile strength of a wet rope is only about one-third that of the same rope when dry; and a rope saturated with grease or soap is weaker still, as the lubricant permits the fibres to slip with greater facility. Hemp rope contracts strongly on being wet, and a dry rope 25 ft. long will shorten to 24 ft. on being wet.

General Articles.

KURRACHEE HARBOUR WORKS.

BEFORE particularly describing these works, it will be convenient to give a sketch of the local characteristics and modern history of the harbour.

Kurrachee harbour (see plan) is situated on the northern border of the Arabian Sea, its entrance light being in latitude $24^{\circ}47'$ north, and longitude $66^{\circ}58'$ east, six miles west of the westernmost angle of the Indus delta, and only one mile west of the "Hujamro," or principal mouth of that river.

The sea bed off Kurrachee dips very much more rapidly than off the eastern angle of the Indus delta, and even more so than off Bombay.

In its formation, Kurrachee is essentially a backwater harbour, of which the lower and smaller, but deeper, division—comprising the entrance and anchorage—depends chiefly for its maintenance of depth on the tidal flow of the upper and larger, but shallower, division, which constitutes the backwater.

The entrance is flanked on the west by the recently constructed breakwater running into five fathoms water, 500 yards S. by E., starting from the base of Manora Point.

This headland is 90 feet in height, consisting of stiff clay cemented by conglomerate rock (large fallen masses of which help to protect the base), and dipping towards the north-west, until, at a distance of half a mile, it meets a reef nine miles in length, extending to the eastward, and on which the surf has formed a beach topped by a ridge of blown sand.

On the extremity of Manora Point stands the tower of the new first order revolving light, adjoining the old Sindhi fort (converted into a residence for the Master Attendant), and one of the batteries of 12-ton guns.

Lower down on the point, and on the sandy flat into which it merges on the harbour side, are quarters, workshops, and store buildings of the port, Indo-European Telegraph (harbour station), and harbour works establishments, and, further on, the quarantine station, and the coaling depot of the British India Steam Navigation Company. On the north-west beach, at one mile from the point, stands a second battery; and at $1\frac{1}{4}$ mile farther, a third, but designed specially to protect the lower harbour, as deep water comes close in shore.

The battery sites are joined by railway lines, aggregating $3\frac{1}{4}$ miles in length, part of which had been previously made for purposes of the Harbour Works.

Eastward from Manora Point to Clifton Hill, opens a shallow bay, $3\frac{1}{4}$ miles in width, on the chord of which, at a distance of $1\frac{1}{4}$ mile from Manora, lie the "Oyster Rock" islets, which, as well as Clifton, are of stratification similar to that of the Manora headland.

From the Clifton shore westward, for a length of $2\frac{1}{2}$ miles, as far as the harbour anchorage, the head of the bay is separated from the eastern backwater by the low sandy ridge of Keamari (300 to 500 yards wide), along which runs the Suez Railway, and which is termed an island, owing to its former separation from the Clifton land by the mouth of the Chinna creek, the closure of which formed part of the improvement works.

From Manora Point, the spit called the Bar runs eastward and the former exposed entrance channel, only 14 feet deep at low water, rounded this spit at 1,000 yards from Manora.

Now, however, the bar is cut across near its root, close to Manora, by the new and sheltered entrance channel 20 fathoms deep at low water, 500 feet wide, and half a mile in length, leading to the lower harbour, which is defined on the east by a stone groyne $1\frac{1}{4}$ mile in length, extending southward from the west end of Keamari Island, and on the west by a sand-bank, extending from Manora to the mouth of the "Tullah" creek, nearly opposite Keamari.

The average width of the lower harbour is about half a mile, its length being rather over two miles, and area at

low water 868 acres, of which, however, only about one-seventh part has a depth of from 20 to 50 feet at low water. Even this is at present reduced by eddies, to about 80 acres, suitable for anchorage and perfectly sheltered, though in shape not favourable for swinging of the largest vessels at low water.

From the head of the lower harbour at Keamari the shallow backwater spreads out west, north, and east, for a total area (at high water spring-tides) of 18 square miles, through which branch numerous creeks and the boat-channel, which—leading to the town wharves or "Native Jetty," and tapping the east backwater—forms, with the jetty, part of the improvement works.

From Keamari to the mainland, the backwater is traversed by the causeway, called (after its originator) the "Napier Mole," nearly two miles long, forming the road communication with Kurrachee, and near the upper end of which, adjoining the "Native Jetty," is an opening 1,200 feet wide, spanned by an iron screw-pile bridge—one of the improvement works—which now passes the tidal flow of the east backwater.

The backwater is covered throughout its entire area by high water of spring-tides, and drains off for the most part freely at low water, thus constituting an immense natural scouring reservoir for the lower harbour and entrance.

The only river discharging into the harbour is the "Layari" which debouches at the head of the backwater, near the town of Kurrachee, but flows at the most only for a few days each year, when heavy rains fall in the hills.

Though at such times this river is of large volume, it is not useful for scour, as it brings down large quantities of sand, which, however, is gradually expelled by the tidal ebb-current.

Altogether, the backwater, shallow as it is, and receiving during the south-west monsoon a copious sand-drift from the sea-beach, and the detritus washed in by the (occasionally heavy, though unfrequent) rainfall round its borders, nevertheless well maintains its capacity, owing greatly to the action of the strong monsoon winds causing a ripple, and stirring up material which passes out with the ebbing tide.

On the contrary, the flood-tide, making round into the harbour from the westward, runs in blue and clear, even during the monsoon, excepting only the local disturbance and eddies caused by the too abrupt ending of the Keamari groyne.

The range of tide at mean springs is $7\frac{1}{4}$ feet, but at extraordinary tides sometimes so much as about 12 feet. The mean range of neap-tides is $3\frac{3}{4}$ feet.

The tidal currents in the entrance attain a maximum of $1\frac{1}{2}$ knots an hour on the flood, and 2 knots on the ebb, but higher up, where throttled by the rocky obstruction called "Deep Water Point," they are more violent and irregular, especially on the ebb, reaching a maximum of $3\frac{1}{4}$ knots.

As regards weather, violent storms are unknown at Kurrachee, which being north of the tropic, is exempt from cyclones; but the south-west monsoon brings a very heavy sea, lasting with full force for about three months, from the middle of June to the middle of September.

The local wind at that season is generally westerly, and seldom exceeds a strong breeze, with a velocity of about 30 miles an hour, equivalent to a pressure of not more than $4\frac{1}{2}$ lbs. per square foot.

The run of the wave is more southerly than the wind, being usually from S. W. by W., having a fetch of 500 miles over a deep sea bottom.

At this time the waves in the deep water at the head of the breakwater attain an observed and frequent maximum of 15 feet in height from hollow to crest, travelling at the rate of 30 nautical miles an hour. Of these high waves, about three-fourths of the elevation is above, and the remainder below, the mean sea-level at the time.

From the middle of October to the end of February is the favourable season for construction of sea works, for

KURRAOHEE HARBOUR

1879.

PLAN

OF

N

S

BREAKWATER

MANORA
POINT

ENTRANCE CHANNEL

DEER WATER POINT

OYSTER
ROCKS

CHINNA CREEK

OLIFTON

CHIZRI
SANITARIUM

PIER

CHIZRI CREEK

KEAMARI ISLAND

H. W. M.

RAILWAY
EMBANKMENT

NEW CHANNEL WEST
NAPIER MOLE

BRIDGE
NEW CHANNEL EAST

NATIVE JETTY

STATION

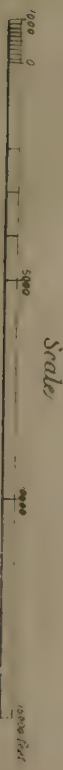
STATION

RAILWAY WORK SHOPS

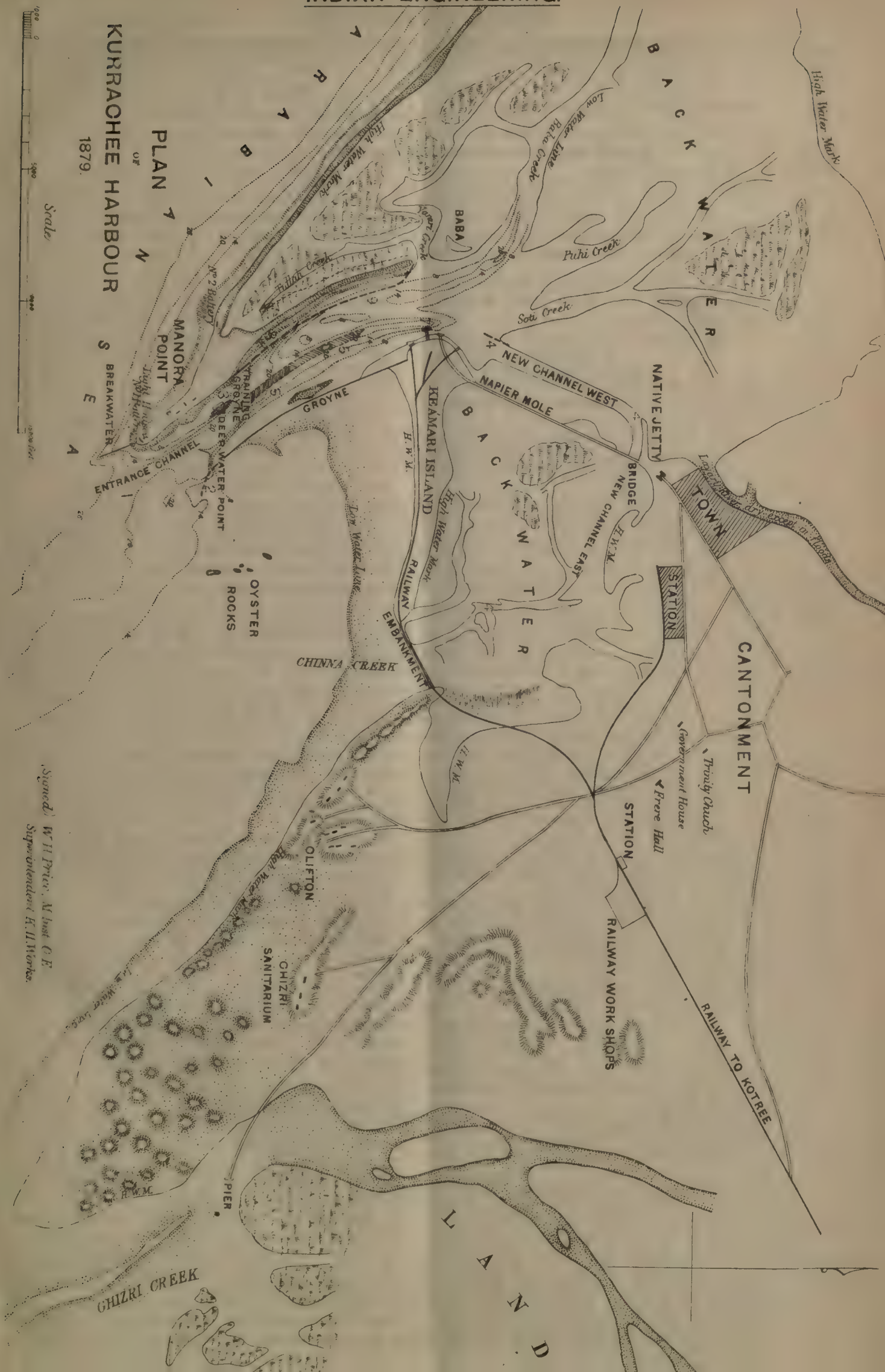
Government House
Trinity Church
Prere Hall

CANTONMENT

RAILWAY TO KOTREE



Signed W. H. Price, M. Inst. C. E.
Superintendent H. M. Works.



though during that time strong easterly winds blow occasionally, they do not bring a heavy sea.

The intervals between the fair season proper and the south-west monsoon are subject to occasional squalls and to strong breezes, chiefly from the westward, raising a sea which is sufficient to interrupt the progress of sea works, though not formidable to navigation.

During the south-west monsoon, for the most part occur the scanty local rains, one or two years sometimes passing with scarcely any fall, and the average being only about 7 inches per annum, even taking into account the unusually heavy falls which occur at intervals of several years.

Thus the operations of trade are but little interrupted by rain, as compared with most other parts in India, which are subject to heavy and continuous monsoon rains, as, for instance, at Bombay, where the average rainfall is more than ten times that of Kurrachee.

(To be continued.)

MINING ENTERPRISE IN CHINA.

BY JOHN HARRIS, M.E.

III.

The Tai-y-Shan Silver Lead Mine.

MR. CANDLER, the manager, was anxious to send the ore to England to be smelted, it having such a variety of combinations which in smelting may prove rebellious; but to this proposal the Chinese Government would not agree, and as the ore could not leave Chinese territory to be treated, it therefore became imperative to erect a reduction and smelting works in the country, which, however, on consideration, it was decided not to erect at Tamchow owing to the difficulties to be contended against with the villagers in obtaining a site and also the position of Tamchow exposing it to the risk of being plundered by pirates. Meantime a lode of silver-lead ore had been found on the island of Tai-Y-Shan near Hong-Kong, and the right to work same was secured by Mr. Ho Amei and his friends, and this place occupying such a favourable position for obtaining supplies of coal and materials generally by sea, it was as well as for shipping the produce of the mines direct, decided to erect some reduction and smelting works there.

Tai-Y-Shan, silver lead mine has been vigorously opened on the lode by means of two adit levels and several winzes to the deep one of which is down 80 feet. The mine generally is bidding fairly well to become a good mine, the ore to the deep, carrying 150ozs. of silver to the ton. For developing to the deep, a hydraulic motor is about to be erected for working a set of 7 inch pumps and for hauling purposes, there being a good supply of water from the surrounding mountains, with a head pressure of 300 feet.

The Reduction and Smelting Works consist of rock breaker, 3 pairs of rolls, 8 jiggers, 2 automatic buddles, and 4 frue vanners all of the most approved type, to a great extent automatic, competent to treat 40 tons of ore per day. The whole of the machinery will be driven by a strong semi-portable engine of the Robey type. The engine, machinery, cast iron columns, and roof for the mill have been supplied by Messrs Robey and Co., Lincoln. The smelting works will for the present consist of 4 scotch hearths, 2 calcining furnaces of the reverberatory type, a reverberatory smelting furnace, and an English cupelling furnace. These are now being put up and are connected by long flues under condensing chamber and smoke stack, the latter standing at a considerable altitude on the hill side to carry the fumes off clear of the works.

Mr. C. S. Turner, a gentleman who has had considerable experience in smelting operations both in England and Russia, is in charge of the erection of the works and will conduct the reduction, smelting and refining operations. The ore from the Tai-Y-Shan mine will be conveyed over a broken country to the smelting works close to the seashore by means of an overhead wire tramway 3,000 feet in length. A complete Labora-

tory has been fitted up together with all the necessary appliances for assaying and analysing ores, metals, &c.

About a year ago, after many representations had been made to the Viceroy of Canton pointing out the advantages that would accrue to the country generally by encouraging *bona fide* mining enterprises, no scheme found favor that necessitated the outlay by this Government of a single dollar; now, however, a Mining Office is established under an officer called the Taotai who is empowered to grant licenses upon payment of a fee of one thousand dollars for permission to open up any mine, after first satisfying himself that the local public have no objection to a mine being opened in their locality. About twenty licenses have been granted, but owing to lack of mining knowledge, continual petty and real obstructions offered by the people, squeezes by the Mandarins, and one thing and another, these, with a few exceptions, have collapsed.

As a rule, the inhabitants don't like ground to be broken for mining for fear of offending the presiding spirits of the earth commonly known as "Fungshui" and thereby bringing them bad luck, which, coupled with their strong objection to having graves disturbed, which are scattered promiscuously all over the country, it is almost impossible to commence mining operations anywhere, without interfering with or insulting their prejudices in one way or another. As soon as one difficulty is paid for and got over another is presented, and so on *ad infinitum*—making the whole business so harassing and expensive that the adventurer's patience is worn out, and his capital exhausted before he can scarcely begin. This Fungshui business is a grand stalking horse for sweating and extorting money under all manner of pretences; besides this the Government appoints a Mandarin to look after its interest in the venture at a high salary, payable by the mine owners, and this official seems to imagine his principal duty is to interfere and squeeze the mine owners under threats of placing all manner of obstacles in their way.

A Royalty of 10 per cent. on the gross out-turn is levied by the Government who continually worry the mine owners about their long delay in making returns and suspect that every body in connection with the exploitation of the mine is trying to cheat them. Labor is plentiful, but, taking into consideration the amount of work done, not cheap. The men are soon taught and some of them shew high intelligence; but amongst the Chinese this is no real qualification for advancement, the Chinese officials in the employ of the mine obtaining the dismissal of these men on the most trivial pretence, more especially if they shew the slightest inclination to be courteous and obliging to the foreign staff. It is quite impossible to arrange for each individual man to be paid his wages direct; these always pass through several hands with the cognizance and connivance of the Chinese office men; reaching the employees in much smaller sums than those recorded in the books. The result is much dissatisfaction on the part of the men, and, furthermore, if complaint is made of a man's dilatoriness he justifies himself by complaining that he is not properly paid and no steps are taken to remedy it. All manner of schemes are resorted to for giving false records of the number of men employed, and wages are often booked for say 50 men, when only about 35 or 40 are actually employed, the amount thus falsely debited to the mine going into the pockets of those acting in collusion in the swindle. The proof of this is found in the fact that no one seems disposed to give any assistance whatever to prevent it; and it is enough to shew that as long as these practices and old customs, which are tacitly understood and winked at, prevail, it will be almost impossible for any mining enterprise, no matter how good, to prosper. It seems to be impossible to convince these people that they are on the wrong track, the stubbornness of the Chinese in persisting in the old customs of squeezing and cheating being proverbial.

CANTON; October 10, 1887.

BHAGALPUR WATER-WORKS.

THE following arrangements are made for the supply of water. A 15" intake pipe is carried from the engine-room out to the river. There is a valve in this to admit or shut off the water from the river. This pipe is laid below the low water level of river, it has a bent rose at river end which is turned down stream.

[The Settling Tanks and Filter Beds will be described and illustrated in our next issue.]

CLEAR WATER WELL.

This is built 40 x 22 with a depth of 20 feet covered with an arched roof.

THE SERVICE RESERVOIR.

This is made of brick masonry. A reference to the drawings will show its form. The floor level is 173 and the level of water is 191. There will, therefore, be a depth of 18 feet when the reservoir is full. The reservoir will be roofed over. Ventilators and a manhole are provided. The reservoir is slightly lowered from the surface to receive the advantage of earth-pressure. To keep the water cool, an earth-covering of 2 feet is made over the masonry roof. The reservoir will hold over 500,000 gallons of filtered water—a quantity considerably in excess of the maximum daily supply.

(To be continued.)

MAIL STEAMERS AND THEIR SPEEDS.

BY A. EWBANK.

THE recent performances on her trips out and home of the S.S. *Poona* have set Anglo-Indians thinking why fifteen or sixteen knots an hour should not become the normal speed for P. and O. mail steamers. Formerly when there only ran to India one line of steamers we had exorbitant fares and slow speeds. Now-a-days fares are reduced, while speed and accommodation are improved.

In considering what further improvements in speed, comfort and economy—to the passenger—are both desirable and possible, we naturally turn our attention to those splendid boats which ply between Liverpool and North America. These boats are filled chiefly with passengers who travel for their own amusement. These passengers are not tied to time like the outward bound Government servant. The travellers across the Atlantic have no notion of accepting exorbitant rates, or deficient accommodation or bad food or slow speeds from one line of steamers, if, by waiting a few days, they can better themselves in any of these respects on a different line of steamers. Thus competition compels the great Atlantic liners quickly to copy each other's improvements. The consequence is that a voyager between Queenstown and New York dwells in a degree of comfort to which our Indian steamers offer no parallel.

Anglo-Indians, however, are less given to complaints of expense or of accommodation than to wrathful contemplation of the miserable eleven knots an hour to which they are often treated. To most men time is money, but to the Anglo-Indian it is something more. The man who essays a run home on a leave of three months, or it may be less, finds himself on a steamer which dawdles on her way as if her Captain had received secret orders to keep his passengers from dry land as long as possible. When the brief leave is nearly finished it becomes to those unfortunate beings who are "permitted to return to duty" a question of absorbing interest whether the journey back from Charing Cross to Apollo Bunder will take sixteen days or fourteen or twelve. It is then that the much-enduring Anglo-Indian indignantly pores over P. and O. time tables and calculates how much of his scanty freedom is ruthlessly clipped away by mail regulation velocities.

In order that the public may make fair terms with managers of steamship lines—who will naturally consult the pockets of the shareholders in preference to the benefit of the public—it is desirable that this many-headed public should know exactly how much to demand. If they seek for impossible concessions the companies—duly advised by experts—find it possible blandly to reply that the thing cannot be done. Then by an utterly non-logical, but entirely natural, transition, the companies go on to assert and the public begin half to believe that no improvement at all is possible.

If we angrily interview our boot maker and inquire why he charges us thirty shillings for a pair of boots which elsewhere seem procurable for shillings twenty-four—and the bootmaker smilingly assures us that the quality of the leather which he makes up is beyond all comparison superior to what the cheap jack uses—we walk off with the pleasant conviction that we were not such fools as we looked—that we really had been having our money's worth all those years during which James Wellington, our respectable boot maker, had, all unknown to ourselves, been piling up a goodly fortune.

Chairmen of great steamship lines, and men who sell shoes by retail, have to be watched by the general public upon the same general principles of watchfulness. It is first of all the business of a chairman or a shoemaker to see that his business pays well, the comfort of the travelling or the tramping public is not an end but a means.

Let us now direct the attention of our readers to the following consideration. The speed which an ocean going steamer can—as a matter of business or as a paying commodity—supply over long distances depends only partially on the perfection of construction to which the steam-engine can attain. Other elements are involved besides human ingenuity, human enterprise and human thoroughness. There are laws—outside the wishes of the Engineer—which regulate the action of steam engines. These laws are laws of nature—laws of the science of heat.

For example suppose that the boiler of a steam engine supplies steam at a temperature of 150° C. Suppose that this steam enters the cylinder and drives the piston. This doing of work must cool the steam—as we learn from the science of heat. Suppose the steam, when its duty is accomplished is dismissed from the machine at a temperature of 50° C. Then coal has been used up in producing from cold water that steam at 150° C. The coal possesses in itself a certain definite store of energy. We cannot extract from the coal more than the energy—more than the driving power—which it really possesses. But can we extract *all* that it possesses.

And how much coal-energy did we actually realise when we heated steam to 150° C and let it escape at 50° C. Questions of this kind can only be answered after study of the science of heat. As regards the latter question it can be proved that in the case of steam beginning to do work at 150° C and ceasing to do work at 50° C we do not get hold even of so much as one quarter of the energy which the coal really possesses.

If to a chance acquaintance we explain that we have designed and constructed a steam engine which utilises 20 per cent. of the coal power supplied—and therefore allows 80 per cent. to be irredeemably lost—it is likely that our acquaintance may give answer that our engine must be a miserable specimen. But if the acquaintance happens to be an Engineer conversant with this subject, he may—after a few more inquiries—warmly congratulate us on the brilliant result achieved. These considerations serve to illustrate the fact that scientific knowledge is not only required to construct a good engine, but also to understand whether and to what extent the engine is really good.

When steam power was first introduced into the Royal Navy it is on record that a certain Admiral—accustomed all his life only to the forces of wind and wave—gazed with some mixture of contempt on the elaborate assortment of valves, joints, tubes and connecting rods which make up a marine engine. "What you want," he said, "is a boiler and a pair of paddles; all the rest is only put in to mystify the public." Without following our worthy Admiral to the extreme limit of his conclusion, we may from him borrow a hint not unduly to mystify the public.

Therefore, in considering the problem before us, we shall confine ourselves to the simplest aspect in which a steam engine can be regarded. We write not for experts, but for the general public unacquainted with all technicalities.

Instead of a boiler and a pair of paddles we may say, a boiler, a cylinder and a pair of paddles or a screw. In the case of a railway locomotive the paddles are turned to wheels.

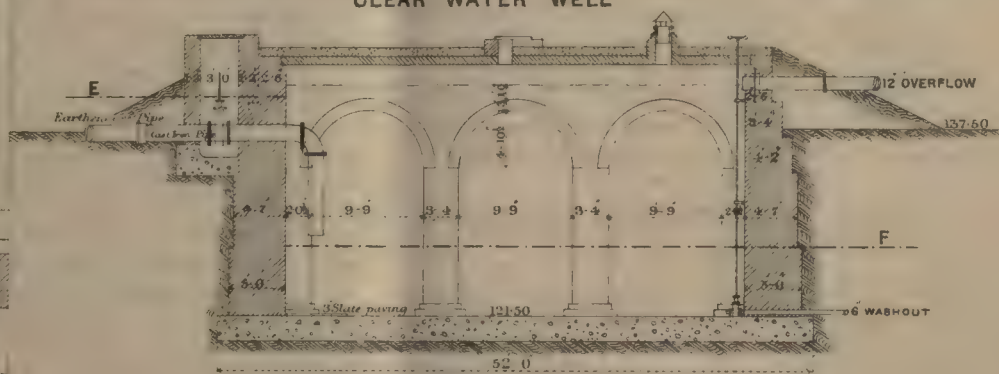
(To be continued.)



SECTION ON LINE C.D.

All four walls built to this section in place of original design.

CLEAR WATER WELL

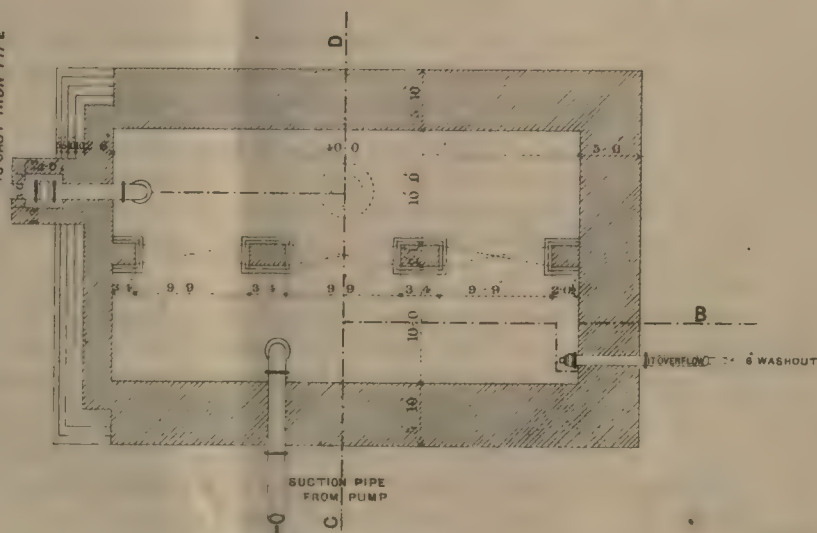


SECTION ON LINE A.B.

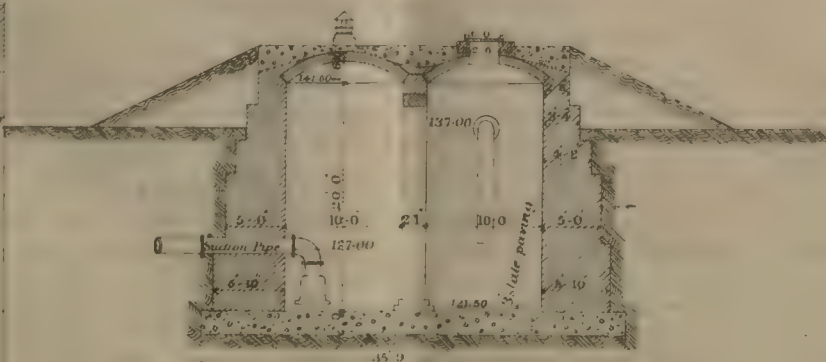
Repair or supply when the Reservoir is empty for level of Top Water to serve for

18" EARTHENWARE PIPE

18" CAST IRON PIPE



PLAN ON LINE E.F.



SECTION ON LINE C.D.

THE DUFFERIN BRIDGE, OUDE AND ROHILKUND RAILWAY, BENARES.

COLONEL DOWDEN'S REPORT.

III.

(Continued from page 430.)

THIS shewed that no saving in expense was likely to result from a departure from the first of these: principally owing to the increased number of piers rendered necessary, in the last two designs, neutralising the saving in superstructure by using smaller spans.

The estimates above, included the cost of plant, no allowance being made for its sale on completion. The rates of cost of *piers* and *superstructure*, by which the above amounts of the estimates had been arrived at, were equal in all cases. The spans recommended, viz., 356', were the smallest which could be adopted, without increasing the number of large piers, and for this reason, Mr. Barlow stated that the bridge so constructed would become cheaper, than one of either larger or smaller spans.

The weights of the platform and moving load allowed for are as follows:—

Moving load ...	1·600 tons per foot run of bridge.		
Ballast ...	0·750 ditto	ditto	
Rails, sleepers, &c. ...	0·050 ditto	ditto	
Platformstructure ...	0·456 ditto	ditto	
	2·856 ditto	ditto	
Main girders 356' span ...	1·690* ditto	ditto	
Viaduct 110' span ...	0·300 ditto	ditto	

* Formula used:—weight of main girders in lbs. per foot run=area in square inches of section at middle of girder $\times 3 \times 3\frac{1}{2}$.

The strain per square inch on the steel work was allowed for at 6·5 tons.

The cost of the Bridge was estimated, in England, as below:—

MAIN BRIDGE.

North Abutment	£	15,000
7 Piers averaging £30,000 each	...	210,000
7 Spans (Steel) 602 tons „ at £37 a ton	...	155,918
		380,918

VIADUCT.

South Abutment ...	...	1,550
8 Piers at £1,142 each	...	9,136
9 Spans (Steel) 83·5 tons each at £37 a ton	...	27,805

	38,491	£
Total ...	380,918 + 38,491 =	419,409
Contingencies ...	5% =	20,976
		440,379

As regards the design of the pier for the large spans, 65' \times 28', the area of the base was 1,430 sq. ft., and the pressure 10·8 ton per square foot. If sunk 90 ft. deep this pressure would be reduced to 5·2 tons by displacement of water and side friction. Taking the crushing force of brickwork at 64 tons per square foot, there would be a factor of safety of 6 in the first case, and 12·5 in the second.

The weight of a pier and its superstructure was likely to be about 15,550 tons gross.

The disaster at the Tay Bridge, which occurred at the time the designs for the Benares Bridge were under consideration, caused considerable attention to be directed to the subject of wind pressure. Taking a pressure of 60lbs. per square foot, and assuming that the pier would overturn on the edge of its base, as a fulcrum, it was ascertained that the stability was as, 7·7 to 1 against failure in this way.

In estimating the resistance of the pier, to the current of water at 15 miles an hour, as well as to a hurricane of wind, it was assumed that failure might happen with a simultaneous scour of 30 ft. With a maximum depth of 110 ft. of water, the power of the pier to resist overturning, at the river bed, was 6 times the force brought against it. With a high flood, there was of course a less

surface of pier exposed to wind pressure, and the weight of a pier was diminished by its submersion in the water.

The contracts for plant and materials of all sorts, were given by the Home Board during the year 1881, for delivery between July of that year and April 1882.

The caisson for the piers, made by P. and W. MacLellan, costing £12,877, and tools, and machinery costing £12,880, arrived in India between August 1881 and February 1882.

The Pontoons with staging, and excavators by Hawks Crawshaw and Sons, which cost £60,600, arrived about the same period. A steam tug "Kasi," which cost £12,500 was found not to be required. It was furnished by Cunliffe and Dunlop. A steam launch, supplied by Alley and MacLellan was very useful. This Firm supplied the Westinghouse pumps, and Bruce and Batho's Excavators, besides sundry steel and iron work. A list of the contracts is given at the end of this pamphlet.

The steel superstructure did not commence to arrive till May 1883, and was not all to hand till April 1885. It was supplied by the Patent Shaft and Axletree Company, "Limited," at a cost of £120,610.

The system adopted in sinking the piers was briefly as follows:—

The caisson having been partially erected on a false deck, between a pair of the pontoons, was lowered, by chain slings, into the water. More plates were then added, and the caisson was further lowered gradually, until it rested on the river bed, its top being still above water level. Masonry was then filled inside, and carried up, in the same form above water. Sinking was done by 3 overhead cranes travelling on the top of the pontoon staging, each carrying a Bruce and Batho's digger of 8 ft. diameter. The soil removed by the diggers was "dumped" into shoots, at the outer sides of the pontoons, and thence into the river.

The average sinking per day of 10 hours including delays in shifting the gear, and also the building up of the masonry, amounted to 86 ft., and the depth sunk per day, while the dredgers were in action, was on the average 1·43 ft. In sinking these piers, many interesting objects were met with; an account of them kindly furnished by Mr. A. Constable of the Company's Engineering Staff, will be found in the appendices at the end.

Only one accident happened during this process. On the 17th of April 1883, while the dredging of material was in progress on No. 4 pier, there was a sudden inrush of sand from below, which forced the water in the pier, over the top of the masonry. The pressure of water from within, burst the pier outwards, and rendered further operations impossible during the season. The cause is supposed to have been the forming of a cavity, below the foundation, by the action of the dredgers, while the pier was prevented from sinking to occupy the hollow so formed, by a bed of clay which intervened. There was no sudden subsidence of the pier; it was held by side friction.

The repair of the pier was rendered practicable by the action of the monsoon floods which, close at hand when the accident happened, washed the broken piece out of place, fortunately leaving the rest intact. The Resident Engineer, Mr. F. T. G. Walton, with ready resource, devised a double shield of iron sheeting, to close in the void; this was then filled in with cement concrete, and sinking was proceeded with.

The plan of erecting the superstructure was as follows. Three 114 ft. iron girder spans supported on clusters of screw piles were employed to temporarily bridge over the space, between the 356' span piers. The Pontoons with their high level stagings, came in very useful for removing and floating in position, the short 114 ft. spans used for this temporary purpose, where the water was deep enough. On these girders, which had to be strengthened for the purpose, with timber struts, was laid a temporary platform capable of bearing gantry cranes. The cranes were used for lifting the various

portions of the main girders into their positions. The rivetting was done by hydraulic machinery.

Where the water in the river was very deep, the bed was filled in with sand, and a bank or artificial island was formed up to low water level, into which the staging piles were screwed.

The large spans were erected, with a camber of 9 inches, which became reduced to 6 inches, on the supports being taken away.

The roadway for cart traffic is formed of buckle plates, with a surfacing of kunkur. The width of the roadway, in the clear, is 22 ft., and there are two pathways, each 5 ft. broad, outside the girders, supported on cantilevers.

A revised estimate for the entire work was sanctioned by the Government of India, on the 11th December 1886, and amounted to Rs. 75,27,526, a sum largely in excess of the original estimate.

In a work of such magnitude, it is instructive to observe, how many items are liable to be unforeseen, even with the most careful forecast. It must be remembered, that, whereas all the local details of the piers, abutments, and approaches had to be taken into consideration by the Chief Engineer in India, the details of the steel and iron work had to be thought out in England, by the Consulting Engineer to the Board.

Then there was the settling of the plan of the erection of the ponderous superstructure, which could only be arranged for by the Indian and English Engineers in concert. Naturally, the first design underwent many modifications in this process, for which the Chief Engineer could be held responsible only, jointly with the Engineers who were charged with the construction of the girders. An important addition to the original design was, 600 ft. more waterway in the viaduct on the right bank of the river. Nearly 4 lakhs of rupees worth of plant was ordered, consequent on a change considered necessary in the plan of erection, after the original plant had been ordered from contractors.

Three-quarters of a lakh of rupees have been spent on Station Buildings, and Military Block-houses at the ends of the Bridge, which were not contemplated when the original estimate was got out.

Over 5½ lakhs rupees has had to be charged for general superintendence and establishment, not entered in the estimate originally sanctioned.

The most important differences in the estimates are:—
Cost of girders erected in position ... Rs. 9,11,580
Stores, tools, plant, steamer, &c. ... " 17,04,563

Total ... Rs. 26,16,143

The rate assumed for girders in position was Rs. 250 per ton, for the 416' spans.

The actual rates have been—

Cost in England ... Rs. 189
Sea freight and landing charges ... " 15
E. I. Railway freight ... " 40
Unloading and stacking ... " 1

Total ... Rs. 245, at site.

The rate for erecting allowed for in the estimate was:—

Large spans, per ton ... Rs. 75
Small " " " ... " 50

But the total cost of erecting the spans, *in place*, when debited with the special plant necessary for their erection, comes to at least Rs. 60 a ton extra. The total cost of erected girders, works out at Rs. 408 per ton, including flooring and painting, but if a share of the general plant for the entire Bridge be allocated to the spans erected, they would have cost about Rs. 436 per ton. The actual cost of erection at date is therefore Rs. 191 per ton.*

The estimates shew that Rs. 17,04,563 have been expended mostly in Plant, and as the whole cost of the Bridge proper, excluding approaches, but including Plant, is only Rs. 60,76,207, the proportion of cost due to Plant

seems excessive. There is, however, no doubt that, it is this very item which must ordinarily cause the expense of erection of large spans at a high elevation, to be so much greater than of small.

Of the total estimate Rs. 75,27,526, a considerable portion has nothing to do with the Bridge proper. 5½ miles of expensive approaches, and diversions of the Grand Trunk and City roads, the station buildings and block-houses, form necessary adjuncts to the undertaking, but no part of the work for which the Engineers in England, and the Company's Chief Engineer in India, were jointly responsible.

The length of the Bridge as now built is—

7 spans of 356 ft. = 2,492 ft.
9 " of 114 " = 1,026 "

3,518 ft.

and the cost is consequently Rs. 1,727 per lineal foot. The cost of large bridges erected elsewhere has been (*vide* Director General of Railways' Administration Report for 1884-85, Part II., pages 50 and 51)—

Bridge.	Large spans in feet.	Depth of foundations below water.	Height of piers from low water level to under side of girders.	Cost per foot of waterway.	Cost of erection only of girders per ton.
Benares Bridge (O. & R. R.) ...	356'	100' sand stone	80'	Rs. 1,727	Rs. 180
Attock Bridge ...	308'	stone	111'	1,887	437
Sutlej (Adamwahan L. V. R.) ...	250'	103' sand	28½'	1,210	105
Ganges Balawall (O. & R. R.)* ...	248'	100' sand	40'	720	00
Jumna (Allahabad E. I. R.) ...	200'	42' sand	60'	1,374	110

* Piers, &c. ... Rs. 9,19,336
Girders ... " 8,54,398
Erection of Girders ... " 2,30,856

Rs. 20,04,590

Weight of 11 spans 3,990 tons. Cost of river training works not included.

The ultimate cost of the Benares Bridge may be largely reduced by sales of Plant; but special Plant is often difficult to sell in India.

The designs, and the works executed in India have been, from their first inception, to the final completion, under the direction, in India, of Mr. H. B. Hederstedt, the Chief Engineer of the Oude and Rohilkund Railway. Up to the 16th May 1886, the designing and direction in England was under the Company's Consulting Engineer, Mr. W. F. Batho; and since the lamented death of that gentleman, under Mr. J. W. H. James, with whom he was associated in partnership, and who succeeded him as Officiating Consulting Engineer to the Company.

The execution of works at Benares, has since October 1881 been uninterruptedly in charge of Mr. F. T. G. Walton, as Resident Engineer, and it is greatly owing to his unremitting exertions and zeal, that the practical difficulties, met with in all such large works, have been so successfully overcome.

Mr. Sydney Hartwell, Officiating for Colonel J. H. Jenkins, the Agent, on leave, has brought to notice the names of the following of the Staff engaged on the Bridge, in addition to those already specially mentioned, as deserving the thanks of the Company for their intelligent interest, and active energy, in pushing on the works in their respective charges.

Mr. S. Crawshaw, Assistant Engineer.

Mr. E. Delanougerede, Clerk of Works.

Foremen.—Messrs. J. Rankine, M. Teague, J. Gemmel, C. McLinton, H. Platt, E. E. Embleton, and P. J. Harper.

Baboo Ramgopal Vidyant, Native Engineer, employed on the designs and working drawings in the Chief Engineer's Office.

The Bridge, which was started in 1879 under the auspices of Sir Andrew Clarke, then Public Works Minister,

*There will be credit for plant which will probably reduce this to 180 Rupees.

was completed during the Ministry of Sir Theodore Hope in 1887. It was tested on the 24th September, and opened for Railway traffic on 1st October 1887.

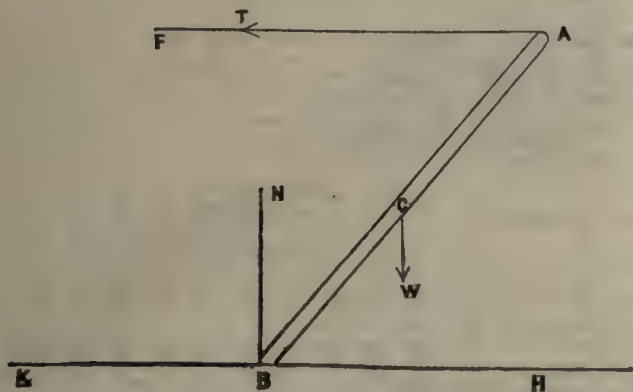
The Administrative control on the part of the Company in India has been exercised by Colonel J. H. Jenkins, the Agent, whose cordial support of the Staff has led to great efficiency and economy in carrying out the undertaking. On the part of the Government of India the control has been exercised locally by the Consulting Engineer for Railways, Lucknow, the incumbents during the construction being Colonels deBourbel, Pemberton, Luard, and Dowden, all of the Royal Engineers

PRINCIPLES OF MECHANICS.

BY A. EW BANK.

V.

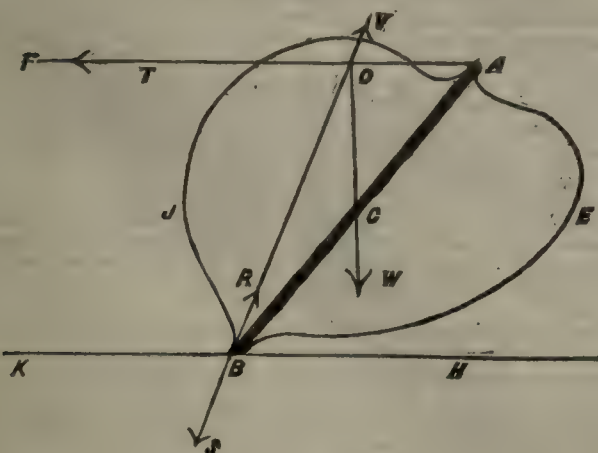
Fig. 19.



In our last paper the student was invited to ascertain for himself the general direction of certain force R acting on a body AB , *fig. 19*. He would have to reason not in an algebraical or geometrical manner, but in what we will call a strictly mechanical or dynamical manner. He has to consider how forces act, and he has no dealings necessarily with any formulæ of pure mathematics. If he has what we may call the true mechanical sense, he will see that though the actual direction may be undetermined—it cannot be indeterminate—and that it must as a force on the body AB slope upwards to the right.

This decision still leaves it an open question whether the force R acts within the angle ABH or within the angle ABN . But that method of transferring the point of application of a force will enable us not only to shew that the force R acts within the angle ABN , but to define its exact position within that angle.

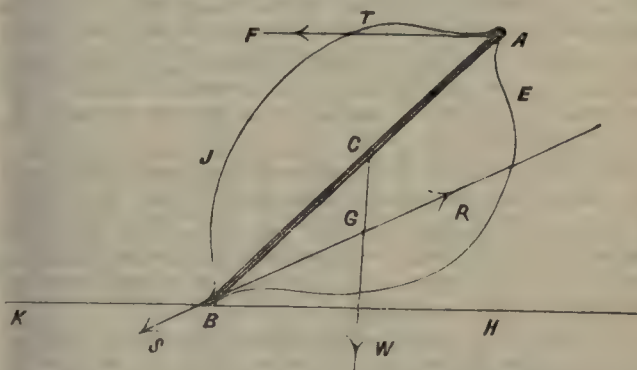
Fig. 20.



We commence by replacing the bar AB by another body $AEBJ$ as shewn in *fig. 20*. If AB be a bar of iron we might imagine it beaten out into the new shape $AEBJ$. But whatever be the material of the bar we imagine it replaced by another body—not necessarily of the same material—but necessarily of equal weight. And the new material must be so distributed that its weight W acts at the same point C as does the weight of the original body.

The object of substituting a new body is to have new points of application for the old forces T , W and R . Thus in *fig. 20*, let the line of action of W , that is the vertical line through C , be produced back or upwards to meet in O the line of action of T . Then the new body must be so extended that O is a point in the new body. As we are discussing this problem chiefly as an illustration of dynamical principles, we will consider whether the force R could possibly be so directed as to lie within the angle ABH . The body AB is supposed to rest or be in equilibrium and the question is—Can there be equilibrium between W , T , and R if R acts in the angle ABH ?

Fig. 21.



For this case take *fig. 21*. Let the supposed line of R meet the line of action of W in a point G . The new body must have this point G within it, *i.e.*, in a part of its mass. Then the force R acting at B may be replaced by R acting—still in the same direction and the same line—at G . For if at B we consider a force S equal to R , but acting downwards, this force S would, if it acted on AB , be destroyed either by R at B acting towards G or by R at G acting towards B G produced. We have—as mechanics say—transferred R from B to G . We could not transfer into any point out of the line BG . We could not, for instance, transfer R to C or to A , unless the real direction R was along BCA .

Having transferred R to G , let us also transfer W to G . Then we have forces W and R acting at G on the new body, since R at B is equivalent to R at G , and W at C is equivalent to W at G . Therefore R at B , combined with W at C , is equivalent to R and W , both at G . Again R and W at G must be equivalent to some force X , which acts in the angle between R and W . Thus the new body instead of being acted on by R , W and T at B , C and A , respectively, is now acted on by the equivalent systems of X at G and T at A . Now whatever ratio R bears to W , *i.e.*, whatever direction within the angle (R, W) is taken by X , we cannot have the two forces T at A and X at G neutralising each other or producing equilibrium in the new body. An appeal is here made not to any formula in algebra or other mathematical subject, but to the mechanical sense of the student. Let him suppose the force X moving about G into all conceivable positions, *i.e.*, into all positions which are inside the angle between R and W . In no case can the forces balance whatever be the magnitude and direction of X . For example, if X was horizontal and (necessarily) to the right, it would in conjunction with T make the body spin or rotate and the direction of spin would be opposite to the motion taken by the hands of a watch.

In fact, if we keep G where it is in the figure, we see that no force whatever passing through G could balance T at A . That is, even if we were free from the restriction that X must act in the angle (R, W) we still could not find a suitable direction for X to destroy completely the effect of T . The only force which can completely neutralise T is a force which is applied at some point in AF or AF produced or FA produced. Moreover, the force must be horizontal and acting towards the right.

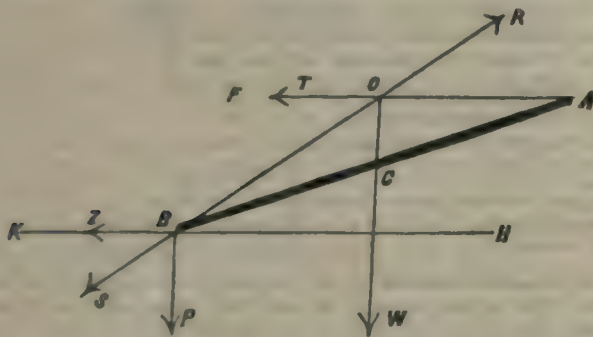
If the student is still doubtful about the impossibility of any force at G balancing the force T , he should take any body handy, such as the lid of a packing case, or a

pad of blotting paper, and endeavour with such a force as T and such a force as X to keep the lid or pad from moving bodily or spinning. Every illustration we have contrived of the action of forces has been so contrived that the student can make the experiment for himself out of materials ordinarily procurable in his house or bungalow. And he is supposed always to make in this way a model and to test the writer's statements by trying them on his model.

We now return to *fig. 20*. We have the lines of action T and W meeting at O. Draw the line B O and produce it to V. Then along this line B O V must act the force R if the new body or if the old body is motionless, for the forces T and W can both be brought to O. They will then be replaceable by some force Y acting at O. Thus our forces reduce to R at B and Y at O. Now these forces cannot balance unless for each of them B O is the line of action. In other words, Y must act towards B and R must act towards O, for R cannot be acting downwards, i.e., along O B produced.

We may, if we like, suppose R transferred to O. We have then R at O balancing Y at O or R at O balancing T and W, both at O. Now if three forces R, T, and W are so connected in magnitudes and directions as to keep at rest any one body, they must, if they keep their respective magnitudes and directions unchanged, keep at rest any other body. Thus T and W and R as now defined in direction, do keep at rest the original bar A B, although we cannot in the case of the bar naturally imagine the forces to act at O, which is a point of space outside the bar. The mathematician, however, does sometimes by a fiction consider the forces to act at O, although O is not in the bar. But we may avoid the "fiction" by replacing our original body A B by a new body, viz., the body A E B J.

Fig. 22.



In *fig. 22* we shew the bar as making a small angle A B H with the floor B H. As this angle decreases, the angle O B H will also decrease. If R is the action of the floor on the bar, then S, which equals R, must be the action of the bar on the floor. Or we may say that S is the force which the lowest layer of particles in the bar feel from all the rest of the body. This lowest layer of particles is then urged by a force S. This force S is equivalent to a pressure P downwards and a horizontal pressure Z. The particles cannot yield to the pressure P unless the floor gives way. But why do they not yield to Z and so move along the floor towards K? If they do not so move, it is because they experience what is called a frictional force or resistance.

Now the smaller is the angle O B H or S B K the greater must be Z compared with P. Thus in desiring the bar to remain at rest under the action of its weight W, a horizontal tension T and a force R exerted on it by the floor, we require that Z the frictional force exerted by the floor on the bar and acting towards H shall have a certain proportion to P the pressure upwards by the floor on the bar. If we lessen the angle A B H, we lessen at the same time the angle O B H, and we now require the ratio of Z to P to have increased. In other words, we need the floor to be effectively rougher. By making the angle O B H still decrease, we at last exceed the roughness which the floor can shew and then the end B slips and the body falls off the floor.

JUBBULPORE WATER WORKS.

SPECIFICATION.

To be observed by the Contractor or Contractors for the making and supplying of certain Cast Iron Pipes and other castings for the Jubbulpore Water Works.

The Cast Iron Pipes required will probably consist of the quantities and sizes mentioned in the following schedule, and must be made in accordance with the particulars stated in the schedule and specification, and according to drawings annexed or to be hereafter furnished.

Total weight with permitted deviation.												
	3	6	8	17	1	17	19	6	9	...	12	
PROPORTIONATE QUANTITY WITH	1	2	...	...	2	1	2	2	...	2	3	
	10	3	15	17	16	17	18	...	17	15	11	
Turned & Bored joints.	1,686	120	43	66	85	14	21	26	47	24	2,138	
	85 %	...	...	...	...	...	...	...	...	...	...
Wide sockets.	15 %	...	...	...	...	...	...	...	...	...	...
	1 %	1 %	2 %	...	3 %	...	...	...	...	...	...
Total weight of Pipes.												
	Tons.	Cwt.	lbs.	Tons.	Cwt.	lbs.	Tons.	Cwt.	lbs.	Tons.	Cwt.	lbs.
No. of Pipes.	3,579	9	...	379	1	...	182	4	...	353	2	...
	3,579	9	...	379	1	...	182	4	...	353	2	...
Mean weight of each pipe.												
	Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.
Depth of socket.	4 1/2"	4 1/2"	4 1/2"	...	8 1/2"	...	...	...	...	...	...	...
	4 1/2"	4 1/2"	4 1/2"	...	8 1/2"	...	...	...	...	...	...	...
Thickness of metal.	9	9	9	9	9	9	9	9	9	9	9	9
	9	9	9	9	9	9	9	9	9	9	9	9
Length of each Pipe.	16"	12"	9"	8"	6"	5"	4 1/2"	4"	3"	2 1/2"	...	...
	16"	12"	9"	8"	6"	5"	4 1/2"	4"	3"	2 1/2"	...	...
Internal diameter when laid.	10,785	1,137	545	1,088	2,007	441	795	1,067	2,603	1,540	...	...
	10,785	1,137	545	1,088	2,007	441	795	1,067	2,603	1,540	...	...
Total	...	...	...	...	...	...	...	...	...	...	...	...

All pipes to have principally turned and bored joints, but a certain number of each to have wide sockets for lead joints. The percentage of this class will be hereafter noted. Generally from 5 to 15 per cent. of each size will have wide sockets for lead joints and the remainder will have turned and bored joints. All pipes above four inches diameter to have 3/8 of an inch for the joint, and the pipes of a lesser diameter than four inches to have 1/4 of an inch for the joint.

Such special or irregular castings as may be required for laying or connecting the whole must be made in conformity with this specification and with drawings and instructions which will be furnished or given by the Executive Engineer, Jubbulpore Division, or other Engineer who may be in charge of the works.

Each pipe to be marked J. W. W. in Roman letters, 1 1/2" long and 1/2" projection and to have the thickness of the castings distinctly cast in figures upon the outside, beneath such figures. Consecutive numbers, according to each size and weight of each Pipe down to those of 5 inches diameter inclusive to be conspicuous by being painted on the outside before delivery.

The straight pipes shall be cast in dry sand moulds, and the curved pipes in loam or dry sand. They are to be cast vertically, and without the use of core nails or thickness pieces or any substitute therefor.

Quantity and strength of metal.—The metal shall be made from mine pig without admixture of cinder iron or other inferior materials, and shall be tough and close grained (and be remelted in the Cupola or air furnace,) and of such strength that a bar of one inch square thirty-eight inches long weighing not more than 10 lbs., will, when supported at points 36 inches apart and loaded in middle, sustain a weight of not less than 700 lbs.

Quality of Pipes.—The pipes shall be free from Scoria, Sand-holes, air-bubbles, cold shuts, laps, washes and other imperfections of casting; and shall be truly cylindrical in the bore, straight in the axis, smooth within and without, and internally of the full specified diameter; and they shall have their inner and outer surfaces as nearly as possible concentric. They shall be perfectly fettled and cleansed, so that no humps or rough places shall be left in the barrels or sockets, and the runners to be carefully cut off so as to preserve a square angle on the

inner edge of the sockets against which the lead joint is to be made; and also to ascertain that the sockets will, in all cases, receive the spigots, and that the spigots will, in all cases, enter into the bottom of the sockets, to ensure which condition a circular iron template of proper dimensions shall be passed to the bottom of every socket and a circular ring of proper dimensions shall be passed over every spigot. The inside of the sockets must not be conical nor the diameter of sockets larger than shewn on drawings. To ensure these conditions it is required that all pipes shall be occasionally put together with iron wedges of sizes representing the proper thickness of the joint as shewn on drawings annexed to this specification.

Coating of Pipes.—The pipes to be carefully coated externally and internally with coal pitch and oil, according to Dr. K. Angus Smith's process. The composition to be applied at proper heat and as soon as possible after the pipes are cast and before any rust sets in.

Testing of Pipes.—The pipes to be tested by Hydrostatic pressure equal to a column of water 300 feet in height, and whilst subject to such pressure to be struck from end to end with a hammer from 5 to 7 lbs. in weight according to the size and strength of the casting. The testing of the pipes and special Castings is to be done by the contractor at the foundry at his expense under the inspection of a person to be appointed by the Engineer. Further, the pipes after being landed and jointed in their several positions and while uncovered shall, from time to time, be tested in such lengths not exceeding 180 yards and at such pressures not exceeding the actual working pressure due to the head of water by more than 50 per cent. as the engineer may consider advisable. For this purpose the contractor shall provide all the necessary apparatus and labor, including Hydraulic pump, &c. The first cost of such apparatus shall be paid to the contractor by the Municipal Committee at the completion of testing, on its being handed over to them in good working condition.

All pipes wherever any sand or air-holes shall be found plugged up are to be rejected.

Special Castings.—The curved pipes and other special Castings shall be executed according to drawings which will be furnished to the Contractor by the Engineer. They must not be made of greater thickness than the straight pipes unless and then only in such manner as shall be directed; and every care must be taken to ensure that these pipes will properly joint with the straight pipes and other castings with which they may be intended to connect, by actually placing such curved pipes in proper connection with standard straight pipes of a like diameter.

Place of Delivery.—The pipes shall be conveyed and delivered by and at the expense of the Contractor to and at the Jubbalpore Railway Station, and should the Contractor who supplies the pipes also undertake the laying of them he will at his expense and risk convey them to the several positions on the pipe line at which they are required. But the Executive Engineer or other Engineer in charge of the works shall be bound to provide a road suitable for Cart Traffic running parallel and generally close to the Pipe Line.

Rate of Delivery.—The pipes shall be delivered as follows:—The Special Castings for the tower and for the culvert shall be delivered not later than the first week of December 1881. At least one-tenth part in value in each of the following months.

And each such delivery shall consist of pipes of such several sizes as the Executive Engineer shall from time to time direct; and all branch pipes, bend pipes, taper pipes, hydrant pipes, and other Special Castings as already noted, shall be delivered as soon as possible after the order for them is given. And in case the Engineer should have reasonable grounds to suppose that the Contractor has not used due diligence in making and delivering such pipes and Special Castings, or any of them, it shall be in the power of the Engineer to order and purchase the same or any substitute for the same elsewhere, and to deduct or cause to be deducted any extra charges thereby incurred from any sum or sums of money which may then be or may afterwards become due or owing to the said contractor, and any pipes so ordered or purchased shall be considered to form part of the number supplied by the said Contractor.

Quantities may be altered.—The quantities and sizes of pipes mentioned in the schedule annexed hereto are believed to be actually the quantities and sizes required. But the Executive Engineer shall nevertheless have the power to vary, extend or diminish the stated quantities, diameters or thicknesses, provided that the gross weight of the Contract be not increased or diminished by such alteration more than 10 per cent. when and as occasion may require from time to time; and in case of any dispute or difference of opinion arising with respect to the meaning or intention of the Contract or of this specification or of the balance finally accruing to the said Contractor or otherwise in relation to the interests of the parties to the contract or either of them, such doubt, dispute or difference of opinion shall from time to time be referred to, and be decided by, the Chief Engineer of the Central Provinces for the time being, whose decisions and awards may be made from time to time and as often as may be required, and shall be final and conclusive upon both parties in the matters to which such decisions and awards shall respectively relate, and this submission to reference may be made a rule of any of the courts of law or equity in India.

Tender how to be made.—The tender shall be made by a Principal or Principals, or by a duly authorized Agent, according to the form annexed, and the same shall be delivered with specification, attached (enclosed in a sealed envelope, endorsed Tender for Pipes and other Castings, J. W. W.) at the office of the Executive Engineer Jubbalpore Division, P. W. D., Jubbalpore, Central Provinces, and addressed to that officer on or before the 17th day of October, 1881, before noon of which day the Tenders received will be opened. Each tender is to be accompanied by Rs. 1,500 either in cash or currency notes as Earnest money. The amount will be returned to unsuccessful tenderers, but that of the party or parties whose tender or tenders is or are accepted will be retained till he has or they have entered into an agreement for the supply of the pipes. The Tenders will be submitted

by the Executive Engineer to the Municipal Committee, Jubbalpore, through the Chief Engineer, C. P., for final acceptance. The person or persons making any accepted tender or any tender a portion of which shall be accepted, shall be entitled to receive a Notification of the acceptance of such tender before the thirtieth day of October 1881. The lowest or any other tender will not necessarily be accepted, though it is intended to do so unless there should appear satisfactory and sufficient reasons to the contrary. The cost of preparing the necessary contract or contracts and surety bond or bonds is to be paid by the party or parties who obtain the contract or contracts.

SPECIFICATION FOR MASONRY DAM.

Foundations.—The foundations are to be excavated to the widths shewn in the drawings, and are in every case to be carried down to the solid rock, which must be without open veins, fissures or cracks of any sort. Should it however be impossible to avoid small fissures (a contingency not unlikely to occur) they must be thoroughly run in with pure Portland cement grouting, and caulked on upper or reservoir side of dam. The bottoms of foundations are to be left in uneven surfaces, and on no account are they to be dressed off to smooth surfaces. They are to be cut in a series of rough steps descending from each side towards the centre, at right angles to the direction of the wall. The angles made by the foot of the dam with the rock are to be filled in with the very best rubble masonry set in the best hydraulic lime mortar (specially prepared) for a height of at least three feet.

2. Masonry.—To consist of uncoursed rubble laid in the best hydraulic lime mortar procurable. The greatest care is to be taken in the construction of this work, and every precaution is to be observed to ensure honest sound work. The stone is to be hard basalt, free from any appearance of disintegration, and before being used in the works it is to be examined and passed by the Engineer in charge. For this purpose the stone will be stacked in convenient sized heaps close to the work, but previous to its removal from the quarries it will be examined by the Engineer as to its fitness. As a general rule the stones are to be of as large size as can be conveniently handled. All the stones are to be thoroughly bedded in the work, and every precaution is to be adopted to prevent hollows being left. All interstices between large stones are to be filled in closely with smaller stones completely imbedded in mortar. Bond stones are to be used occasionally as the Engineer may direct, but they are not to be laid as in ordinary rubble walling, i.e., only at right angles or parallel to the walls, but in every possible direction. The masonry from the base to the top is to be of the same description, homogeneous in fact throughout its length and breadth. Water is to be used freely to keep the masonry wet until the mortar has firmly set. It is to be particularly understood that the masonry is not to be coursed but to be carried up in uneven and unequal heights. The wall will be built with stepped faces not with sloping as shewn in section.

3. Mortar.—The limestone from which the mortar is to be prepared is to be procured from the quarries, distant some three miles from site. It is to be of approved quality and so far as possible of uniform texture. It is to be conveyed to the dam site, and is to be burned there in kilns of the same pattern as are in use now at Pachperi. Charcoal is to be used as a fuel, or coal if it can be obtained for less. Proper sheds are to be constructed close to the mortar mills to store the calcined stone, and on no account is the stone to be slaked until it is required for mortar. It is to be slaked in the ordinary manner, and to be passed through a sieve of 16 meshes to the linear inch before being made into mortar. It is to be mixed in equal proportions in a dry state (all by measure) with clean sharp river sand free from vegetable or other impurities, and surki made from under burned, not over burned, brick bats specially prepared for the purpose from clay of approved quality. The amount of firing to which the clay for surki is to be subjected should be that necessary to expel moisture, and not more. A practical test that the clay is not underbaked, is that it has lost the power of plasticity when mixed with water. Vitrified clay is useless for surki which is intended in combination with a fat lime to produce a hydraulic mortar. It is then to be ground in a mortar mill, driven either by steam or bullock power, so much water as required being added till it is intimately mixed. This process, if by bullock power, will, as a rule, occupy four hours. The surki is to be minutely powdered and is also to be passed through a sieve of 64 meshes to the square inch. The mortar is to be used fresh and fresh. Mortar remaining over from previous day's work on no account to be used. The greatest care is to be exhibited in the selection of good lime and other materials.

4. Concrete.—In the parts of foundation where concrete is to be used (only where the dam is under 40 feet in height) the surfaces of the rock are to be uneven. The concrete is to be composed of 90 parts of basalt stone, broken into cubes of not more than 1½ inch along the greatest diagonal, to 30 parts of lime mortar prepared as described already. The stone is to be of the hardest and soundest procurable. It is to be thoroughly washed before being used. The mortar and stone are to be intimately mixed by being worked about with shovels or rakes. No water is to be added in this process. No layer is to exceed nine inches in height, and each layer is to be thoroughly consolidated before another is put down. The surface of the finished layer is to be grooved with a pick before the next is commenced. The layers are not to be carried across the width of the dam in equal heights, but irregularly, so as to present as many obstacles to the passage of water as possible. The whole of this work is to be done under the personal supervision of the officer in charge of the work. On no account is the consolidation to be considered completed, or a new layer to be commenced, until passed by him. The concrete is to be beaten with wooden rammers shod with iron, or cast-iron rammers, having rectangular faces about 12 inches x 4 inches. All masonry and concrete, of whatever description, is to be carefully protected from the sun immediately after building, by means of mats and grass kept constantly wet. It is of the utmost importance not to permit work of the kind specified from getting immediately dried. It is essential to good work that the natural operation of setting be allowed its proper time, and this can only be attained by arresting the evaporation of the moisture in the work.

3. *Tower Masonry.*—Is to be of uncoursed rubble, of which the outer 2 feet are to be laid in Portland cement. The stones in this part are to be hammer dressed with roughly squared joints fitting as closely as possible. Joint is to be broken in every direction, and as frequently as possible consistent with the use of stones of good size. The casing over the culvert is to be of best rubble in hydraulic mortar, and is to be plastered over with lynch thick of Portland cement. The joints in the faces of Tower are to be well filled in with Portland cement.

6. *Culvert.*—The foundations are to be as shewn in drawings. They are to be of superior rubble masonry. The angles made by the footings with the rock are to be filled in with rubble stone in Portland cement for a depth of at least 18 inches. The culvert is to be of dressed sandstone of superior quality, procured from the Bhundera range of hills, near the village of Katangi. This is a very hard indurated red sandstone, quite impervious to water and very sound. It is to be of the best quality, entirely free from all soft veins, flaws, or other defects. The culvert is to be an oval, that being thought the best form to give it. The whole is to be as already mentioned of indurated sandstone. The stones are to be laid in regular courses all through the culvert with close side and end joints properly bonded with each other. Each stone is to be beaten to its bed with a heavy wooden mallet. The stones are to run from 2 to 4 feet in length or upwards, and none to be less than nine inches across the soffits. They are to be correctly radiated, and to be fine dressed at sides and intrados. The extrados is to be left rough and the stones may vary six inches in depth, but none is to have a less depth than 18 inches. In no case to break joint less than nine inches. Portland cement is to be used in this work and no other mortar to be allowed.

IRON WORK.

7. *Cast Iron Pipes.*—All 16 inch pipes to have generally turned and faced joints, a percentage to have wide sockets for lead joints. The number will be determined hereafter. For all sizes over 4 inch diameter $\frac{3}{4}$ of an inch to be allowed for width of joints, for 4 inch diameter and less the joint to be 1 inch.

8. The pipes to be cast vertically in dry sand moulds, and to be of uniform bore and thickness of metal throughout. The whole to be of the best grey metal, remelted from the cupola, and to be perfectly free from flaws and defects of every kind.

9. The pipes to be carefully coated internally and externally with coal pitch and oil, according to Dr. R. Angus Smith's process. The coating to be applied at a proper heat, and as soon as possible after the pipes are cast, and before any rust sets in.

10. The pipes to be tested by hydraulic pressure equal to a column of water 300 ft. in height, and whilst subject to such pressure to be struck by a 5 lb. hammer from end to end. All pipes wherein any sand or air holes shall be found plugged up to be rejected.

11. 131 street wells of a good pattern will be required. The cocks on the steel posts for drinking purposes must be of strong manufacture and self-closing. The hydrant to have a clear way, and to be of the screw down valve arrangement.

12. For special pipes required such as those for tower, bends, and branches in mains, arrangements for air valves, scouring sluices, &c., drawings will be furnished hereafter. The mouth of each of the inlet pipes of tower to be covered by a galvanized globular shaped wire-strainer 5 meshes to an inch, attached to a wrought-iron frame of suitable diameter.

13. When considered necessary the pipes after being jointed and while uncovered shall from time to time be tested in such lengths not exceeding 180 yards, and at such pressures not exceeding the actual (working) pressure due to the head of water by more than 50 per cent. so that no over-stress be laid on them. For this purpose a common hydraulic pump capable of easy transport in a hand barrow, a short length of strong hose, and a blank flange for attachment to the socket of the last pipe in such length tested will be procured. Water for the purpose can be obtained from the nalas and wells adjacent to the line of piping.

J. G. H. GLASS, Mem. Inst. C. E.,
Executive Engineer, P. W. D.,
Jubbulpore Division.

MINING IN GREAT BRITAIN.

(From our own Correspondent.)

A SINGULAR accident is reported to have taken place at a patent fuel works in Saxony. The coal-dust ignited and produced a most serious explosion in the drying room, maintained at a temperature varying from 165° to 180° Fah. Fifteen persons were seriously injured, out of forty-five persons employed in the works.

The death of Mr. Robert Hunt, at the age of 80 years, will be regretted by many as the loss of a valued friend, who has done faithful service for the mining industries of Great Britain. He was a chemist in his early days, but his attention was soon diverted into mining pursuits. He will be chiefly remembered as keeper of the Mining Records, which were pushed under his direction until his retirement a few years ago.

Science may claim another victim. The so-called meteorite which has been shewn for many years in the courtyard of the Polytechnikum at Aix-la-Chapelle, has been examined by Professor Arruzni. He states that it is simply a gigantic piece of slag, which had accumulated at the bottom of a primitive smelting furnace. It was discovered in 1762, in clearing out the site of a new street.

Some doubts having been raised as to the safety of using carbonit in the presence of coal-dust and firedamp, the patentees have made a series of experiments at Schlebusch in Germany. The trials were made on an experimental drift in the presence of a large number of mining engineers and the results appear to be satisfactory. The charges were embedded in coal-dust whose temperature had been raised to about 85° Fah. Carbonit was used alternately with blasting powder and dynamite. In the case of blasting powder, a violent explosion was produced, and flame appeared at the entrance of the drift. With dynamite, the ignition of the coal-dust was much less violent and complete. Carbonit, fired under precisely similar conditions in presence and absence of firedamp, failed in every instance to ignite the coal-dust or firedamp. Such experiments must be received with some hesitation, and the results must not be accepted as absolute proof that the explosive will not ignite coal-dust or firedamp. The most competent authorities are agreed that at ordinary temperatures and pressures a cloud of coal-dust and air, in the presence or absence of firedamp, can only be ignited when certain conditions are fulfilled. Thus in mine explosions, thousands of shots are fired with impunity and a time arrives when of three shots fired at short intervals the last shot is fired—all the conditions are fulfilled (what they may be, is as yet unknown)—and a disastrous explosion follows. Your readers should, therefore, consider that in experiments with carbonit or other high explosives, the conditions may not have been secured, which would have caused it to ignite or produce an explosion of firedamp or coal-dust.

It seems probable that several years will elapse before electrical mining lamps come into general use. At present it is extremely problematical whether the heavy cost of installation will be recouped by durability and lessened cost of maintenance. The relative economy of the use of electrical or oil lamps can only be determined by trials upon a large scale and after a lengthened period of practical use. The estimates of costs by inventors cannot always be accepted, and should always be rigidly examined and subjected to practical tests.

Some light will be thrown upon the physical geography of the carboniferous formation, if it be proved to be true that each coal seam is connected with those above and below as set forth by Mr. Walton Brown, in a recent paper read before the North of England Institute of Mining and Mechanical Engineers. It is possible that the various seams of coal in the true coal measures should be considered as being portions of one and the same seam, (with intercalated bands or beds of sandstone, shale and other rocks,) which was in continuous formation during a long period of time. Mr. Brown's theory is an absolutely new fact, and if not capable of proof for all the seams in the Great Northern Coalfield, its truth for some of them is very apparent.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, December 24, 1887.

Lower Burma.

With reference to *Burma Gazette* Notifications, dated the 12th and 16th December 1887, Mr. H. Kench, Executive Engineer, 4th grade, temporary rank, made over, and Mr. E. M. Sage, Executive Engineer, 4th grade, sub. *pro tem.*, received, charge of the Toungoo Division on the forenoon of the 16th December 1887.

Lieutenant W. R. Morton, R.E., Assistant Engineer, 1st grade, attached to the Public Works Secretariat, Lower Burma, is granted 14 days' privilege leave, with effect from the 2nd January 1888.

Punjab, December 29, 1887.

Irrigation Branch.

Mr. F. W. Carne, Assistant Engineer, 2nd grade, from the 5th Division, Sirhind Canal, which he left on the forenoon of the 1st December 1887, to the 3rd Division, Sirhind Canal, which he joined on the forenoon of the 5th idem.

India, December 31, 1887.

The services of Mr. A. R. Macdonald, Assistant Engineer, 1st grade, State Railways, employed under the Bombay, Baroda and Central India Railway Company, are placed at the disposal of the Foreign Department for employment in the Gwalior State.

Mr. T. W. Grant, Executive Engineer, 2nd grade, sub. *pro tem.*, State Railways, is granted special leave for one year, in continuation of the furlough granted him by the Director-General of Railways in Notification, dated 1st March 1887.

Major A. S. W. Connor, B.S.C., Executive Engineer, 2nd grade, State Railways, is temporarily transferred to Central India.

Public Works Department Notification, dated 22nd November 1887, for Mr. A. C. Evans, Executive Engineer, 4th grade, sub. *pro tem.*, read Mr. C. T. Evans, Executive Engineer, 2nd grade.

Mr. C. T. Evans, Executive Engineer, 2nd grade, North-Western Provinces and Oudh, temporarily employed in Baluchistan, is retransferred to the North-Western Provinces and Oudh.

Lieutenant Alain Chartier de Lotbiniere Joly, R.E., is appointed to the Department as an Assistant Engineer, 2nd grade, but will remain at the disposal of the Military Department till such time as his services can be made available.

With reference to Public Works Department Notification, dated 3rd March 1887, Lieutenant E. Houston, R.E., is appointed to the Department as an Assistant Engineer, 2nd grade, with effect from the 1st January 1886.

Colonel C. H. Luard, R.E., Chief Engineer, 2nd class, State Railways, is granted special leave for two months, in extension of the furlough already granted him.

The services of the undermentioned officers attached to State Railways are temporarily placed at the disposal of the Military Department for employment in the Military Works Department:—

Major W. W. B. Whiteford, R.E., Executive Engineer, 2nd grade.

Lieutenant S. L. Craster, R.E., Assistant Engineer, 2nd grade.

Lieutenant E. W. Walton, R.E., Assistant Engineer, 2nd grade.

Baluchistan.

Mr. R. T. Denne, Assistant Engineer, 1st grade, temporarily transferred to Baluchistan, reported his arrival at Quetta on the 26th November 1887, and is posted to the 1st Division, Frontier Road.

Mr. W. H. Rushton, Assistant Engineer, 1st grade, is transferred from the 1st to the 2nd Division, Frontier Road.

Director-General of Railways.

Rai Bahadur Kali Podo Sen, Executive Engineer, 3rd grade, sub. *pro tem.*, is granted three months' leave on medical certificate, with effect from the afternoon of 7th December 1887. Director-General's Notification, dated 23rd November 1887, is hereby cancelled.

Rai Sahib Sivadatta Pande, Assistant Engineer, 1st grade, is granted leave on medical certificate for three months and twenty-two days, with effect from 8th December 1887.

With reference to Public Works Department Notification, dated 27th December 1887, Director-General of Railways' Notification, dated 14th December 1887, posting Mr. T. W. Grant, Executive Engineer, 2nd grade, sub. *pro tem.*, to the Toungoo-Mandalay Extension of the Burma State Railway, is hereby cancelled.

Assam, December 31, 1887.

Mr. G. W. Winckler, Executive Engineer, 3rd grade, and District Engineer, Cachar, is granted one year's special leave under the terms of Public Works Department, dated the 3rd October 1887, and under the authority granted in paragraph 4 of Government of India Public Works Department letter, dated the 21st idem.

Mr. D. J. Clancey, Assistant Engineer, 1st grade, is, in the interests of the public service, transferred from the Khasi and Jaintia Hills Division to the Cachar District, and appointed to officiate as District Engineer of Cachar, *vice* Mr. G. W. Winckler, Executive Engineer, proceeding on special leave.

Bengal, January 4, 1888.

Establishment—General.

The services of Mr. W. P. Milne, Executive Engineer, attached to the Chittagong Division, are placed temporarily at the disposal of the Railway Branch for employment on the Assam-Bihar State Railway.

Mr. H. C. Barnes, Executive Engineer, has been granted by Her Majesty's Secretary of State for India, an extension of six months' extraordinary leave on medical certificate.

Messrs. A. E. Silk and G. C. Stawell, Assistant Engineers, 1st grade, passed the examination in reading native letters and accounts on the 28th December 1887.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 29th December 1887.

94 of '87.—Robert Albert Townsend, of Sibi, Beloochistan, in India. —For improvements in the manufacture of wheels for all kinds of vehicles.

98 of '87.—Hamilton Lindsay Bucknall, of No. 7, Westminster Chambers, Westminster, in the County of Middlesex, England, Engineer.—For improvements in securing rails or chairs and tie bars to railway and tramway sleepers made of glass, stone, clay and other hard materials.

197 of '87.—Edward William Serrell, Junior, Civil Engineer, of New York, United States, temporarily residing in Chabeuil, Department of the Drôme, France, and Edouard Fougeirol, Civil Engineer, Member of the French Chamber of Deputies, residing at Paris, 125, Boulevard Saint Germain.—For process and machinery for preparing silk cocoons for reeling.

202 of '87.—Edward William Serrell, Junior, Civil Engineer, of New York, United States, temporarily residing in Chabeuil, Department of the Drôme, France.—For improvements in machinery for reeling silk from the cocoon.

205 of '87.—Edward William Serrell, Junior, Civil Engineer, of New York, United States, temporarily residing in Chabeuil, Department of the Drôme, France.—For process and machinery for the mechanical "debavay" or cleaning of cocoons after brushing.

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NOTIFICATION.

BANGALORE WATER-SUPPLY PROJECT.

Adverting to the last clause of Public Works Department Notification, dated 20th October 1887, published on the 12th, 19th, and 26th November 1887, the time allowed for submission of Essays to the Chief Engineer is extended from the 31st March 1888 to the 15th May 1888.

W. L. C. BADDELEY, CAPTAIN, R.E.,

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Obituary.

WILLIAMSON.—At Chittagong, on the 27th December, 1887, of pneumonia, James Franklin Williamson, Executive Engineer, P. W. Dept., aged 53 years.

INDIAN ENGINEERING.

SATURDAY, JANUARY 14, 1888.

RAILWAY RATES AND FARES.

THE question of railway rates and fares has long been a burning and a complicated one.

Recourse to the Law Courts, notwithstanding, it has not been authoritatively settled in England yet: in India it gives rise to continual bickerings between rival Railway managements, and again between those managements and the public. Last August Colonel Conway Gordon, Director General of Indian Railways, wrote a Minute on the subject which covers twenty pages of a late issue of the *Gazette of India*, and gives a list of 17 works on rates and fares referred to as authorities in the preparation of the Minute, which in turn serves as part of the text for a Government Resolution.

The Director General writes:—"There is literally no end to the difficulties which beset the apparently simple question of determining the actual cost of carriage. It varies with different classes of goods. It varies according to the direction in which the same goods are carried. It varies from day to day, and on different sections of the same railway. The cost of the carriage of any ton or number of tons carried by rail, can never be accurately apportioned. It varies daily. With odd general traffic carried by Railways under constantly changing circumstances it is impossible to assess the rate rateably." The Secretary of State for India is of opinion that rates and fares on Indian Railways should be dealt with as nearly as possible as they would be by independent companies. He would give Railway Managers a free hand, that is to say, only interfering in cases where, under the security of a guarantee, they might fix rates below what would cover the cost of transport with a margin of profit. The Government of India accepts this principle unreservedly, but thinks at the same time that in order to protect the public and to prevent unreasonable charges on the part of the Railway Administrations, it is necessary for Government to impose restrictions as regards the maxima fares to be levied for the carriage of all classes of passengers, and the maxima rates for all descriptions of goods.

This is a principle that has been recognized in every English Railway Act, and in all the Continental ones, as well as in all the American Acts authorizing the construction of Railways. About its application to India, Colonel Conway Gordon writes:—"Legal maxima rates afford little real protection to the public, since they are usually fixed so high that it is, or becomes sooner or later, the interest of the Railway Administrations to carry at lower rates." If that means anything at all it must mean that the less Government interferes with Railway management, and natural laws of supply and demand, the better it will be for all parties concerned. The Government of India blandly recognises the economic postulate; but enters protest against "undue preference." Railway Administrations, that is to say, ought not to be permitted to make preferential bargains with particular persons or companies,

such as granting them scales of charges more or less favourable than those granted to the public generally. Again, in cases where the traffic offering is sufficient to justify this arrangement, Railway Administrations must give reasonable facilities for public traffic between any two Railway stations, each Railway Administration being contented to receive for its share of the through rate less than its ordinary local rate.

The Director General of Railways thinks as to that matter that "the very fact of having any goods classification at all—and no one would dispute the convenience of having a classification—is nothing but recognizing preferential rates for certain articles." This argument seems to us logically incontrovertible, and helps on our contention that Government had better leave Railway managements to conduct their own business in their own way; the commercial way in which all other business concerns in the country are conducted. Indian Railways were well enough managed as to rates and fares, as well as other matter, before Government took over their management. We fail to see what benefit can arise, what good end can possibly be served by higgling interferences with the free, natural course of trade. It seems to us that experienced Railway Managers are likely to know their own business, the business to which they have served an apprenticeship, so to speak, a great deal better than dilettante Government officials who have enjoyed no such advantage, can know it. Would it not be better to leave Railway Managers to do their work in their way, holding them answerable for its proper performance?

The following is, we are told, the section of the American Railway Act dealing with terminals:—

"All charges made for any service rendered, or to be rendered, in the transportation of passengers or property as aforesaid, or in connection therewith, or for the receiving, delivering, storage, or handling of such property, shall be reasonable and just; and every unjust and unreasonable charge for such service is prohibited, and declared to be unlawful."

Could a Sunday School Primer have put the matter more priggishly, and more indefinitely? Colonel Conway Gordon writes:—"Were Government to fix a maximum terminal, it would have to be a maximum sufficient to cover the heaviest expense the Railway Administration might incur in working the traffic at any one station, so that the Railway Administration everywhere else would be practically unrestrained." Another argument in short against meddling interference.

Here are some more from the same armoury:—"It is not sound policy to interfere too much in the details of Railway charges. The circumstances in which Railway Companies find themselves placed from time to time are so very various that the rates should be left, to a great extent, with the companies themselves. The companies know their own interests, and their interests are almost identical with those of the public.

Government interference would be a restraint of trade which eventually would be a mischief to the public."

The fixing of all working rates is far too great a business for any Government department to undertake; such a de-

partment simply could not do it. Enough! No more need be said on the subject, at present at any rate. We have extracted from the Director General's 20 pages of elaborate argument, and from the Government Resolution thereon all that is salient. Except Sir Bradford Leslie's admirable remarks about through traffic. Here they are:

"The various Railway systems should, as far as possible, serve the country as if they were under one management, and the dealer in country produce should not be hampered in his operations by the necessity to base his calculations on as many different scales of rates as there may be Railways between the starting point and destination. This can only be attained by adopting a uniform scale of rates for special or lower class goods which form the bulk of the country trade, and where there are alternative routes, by sending goods according to sender's option. The adoption of a uniform scale of rates for special class goods for the whole of the district served by East Indian Railway and Oudh and Rohilkhand Railway will in my opinion contribute largely to develop traffic.

"It will be in my opinion to the material advantage of the two Railways, and interests of the public to adopt a uniform gradation scale of rates for special class goods, both for through and local traffic on both Railways, the earnings from through traffic to be divided in the ratio of the mileage."

Colonel Conway Gordon thinks it a pity that Government did not accept these principles, which it seems were put forward seven years ago. So do we.

SIR THEODORE HOPE'S WORK.

PROBABLY a more energetic and persevering Indian Public Works Minister than Sir Theodore Hope never struggled against the difficulties that beset such a position, with the result that his seven years' tenure of office has been distinguished by an amount of substantial progress which to Anglo-Indians who have lived long under older dispensations, and know how many official wheels within wheels have to be set in motion, before anything real can be done in this land of chuprassees and office boxes seems marvellous almost. Sir Theodore's record of work accomplished under his auspices during a seven years' incumbency of office is one any man might feel proud of. And now, after the toil a time of reward has come; a time of well-earned ease, and the homeland, and resting on laurels won. We feel sure that our late Public Works Minister carries with him to his retirement the good wishes of all readers of INDIAN ENGINEERING. Some reference to great engineering works accomplished during his tenure of office is imperative on us. Of little ones too. Although not so sensational, they are often of more real benefit to the country at large; and in their own way involve quite as much expenditure of talent.

Sir Theodore Hope's administration was chiefly noticeable for railway extensions. During the seven years he held the Public Works portfolio some 7,000 miles of communication were added to the Indian Railway system. That would not seem much of a result in America. But then America is a rich country, and India is a poor one, desperately poor, and the trustees of its revenues naturally and properly enough incline to be tight-fisted

rather than open-handed. Hence the difficulty; the amount of argument, persuasion, pressure necessary to induce any Indian Government to disburse public money, however commendable the object in view may be. And private enterprize—English capital that is to say—is only just beginning to regard Indian Railways as a possible investment for its monies; an investment likely to prove more profitable than Peruvian Bonds or Bubble companies. Our late Public Works Minister had many a hard fight to secure allotments of public money for railway construction, save when the lines proposed were intended for frontier defence, or famine insurance. What he managed to accomplish is a tale of fulfilment that must be judged by an Indian, and not by American, or European standards. We have no hesitation in calling it a very satisfactory tale of fulfilment. It should be remembered in this connection that the frontier railways constructed for defensive purposes, as a safeguard against invasion have been necessarily costly; and inasmuch as they have been costly, they have robbed the country of internal extensions. More than 500 miles of these military lines, have interfered seriously with the prospects of railway construction in parts of the country where three or four miles of track could have been laid down for every one mile that was laid down on the frontier over a difficult, not easily accessible country, and at emergency rates. If you want work done quickly and well, you must pay correspondingly. In this matter of frontier railways, as in other matters connected with his administration, Sir Theodore Hope must have the credit of fighting tough engineering battles in Council, and supporting manfully the efforts of the engineering staff.

During the late Public Works Minister's tenure of office, the Madras Harbour Works were commenced, the Kiddyapore dock project was sanctioned for Calcutta, the Prince's dock extension for Bombay.

When Sir Theodore Hope took office there were 6½ million acres of land under irrigation throughout the country. Last year there were 7½ million acres. The canal system has been largely developed. The Sirhind; the Chenab and Swat river canals, and the Betwa canal, are instances in point, not to mention the Orissa Lower Canal in Bengal, and the Buckingham canal in Madras. The capital outlay on minor irrigation works has risen from Rs. 259½ lakhs in 1879-80 to Rs. 406½ lakhs in 1886-87, with a satisfactory corresponding increase of net revenue from Rs. 8½ lakhs to Rs. 16½ lakhs.

Altogether, India has now some 27,000 miles of irrigation canal to the good, as an insurance against her perpetually recurring famines.

Military roads in Beloochistan were commenced in 1885, having in view a total length of 345 miles. Fair progress is being made with them, as with the military road connecting Ranikhet with the railway. In Burma, the work of road making has been well begun, and is being pushed on heartily. Roads in India proper have not been neglected; but require no special mention here.

The Bengal Secretariat, the Central Press, and the New Treasury Offices at Calcutta are architectural triumphs

that have risen up during the last seven years. At Simla, there are the Viceregal Lodge, and Secretariat and departmental offices. Of course a lot more good work in the building line has been done, but these instances will suffice for example; and we must not weary our readers with details. Wherefore we will say nothing about bridges, either big or little, which have sprung into existence since 1880. The story of the former is fresh in men's minds; the latter, like Canning's needy Knifegrinder, have no story to tell.

We have written enough in the way of recapitulation and instance to recall to peoples' memories the fact that a vast amount of good engineering work was successfully accomplished during Sir Theodore Hope's tenure of office as Public Works Minister. Quite enough to distinguish it as a progressive era.

SIR ALFRED LYALL AND HIS SATRAPY.

SIR ALFRED LYALL was, we take it, like a good many more of us, a man who mistook his vocation. He had talent; but it was of the literary rather than the administrative order. In the dignity of a professorial chair at Oxford he would have found work more congenial to the bent of his genius, we take it, than he was ever able to find for himself as Secretary of the N.-W. P. and Oudh. Like other men similarly circumstanced, he has felt it incumbent on him to give to the world an *apologia pro regno suo* which now lies before us and claims to be a record of administration in the N.-W. P. and Oudh from April 1882 to November 1887. Sir Rivers Thompson treated us to a similar review of his consulate not long ago. Who pays the cost of these vainglorious retrospects?

Sir Alfred Lyall's rendering of his stewardship comes within INDIAN ENGINEERING purview inasmuch as it goes off at a canter on its first page into "Public Works, Buildings and Roads," and deals with matters which we are bidden remember "have been of some importance." The writer of the report seems to consider that they derive extra importance from their connection with Lokil Sluff. It may interest some of our readers to be told that at the present time "the Boards are practically unfettered in the management of their finances, and have full control of their local budget." It may occur to some Engineers and others to think that the interests of the public would be better served, if managing agencies were a little less unfettered, and irresponsible. From an administrative point of view, the Lokil Sluff system has, we are told, worked successfully, although it is not made apparent that much has been done, beyond expenditure of 129 lakhs of rupees. Of the new first-class roads metalled and bridged, the chief portions have been short lengths of railway feeder-roads, connecting the main road lines of the province, with adjoining Railway lines. In Bundelkhand, where the state of communications is still backward, upwards of Rs. 5 lakhs have been expended since 1882 in metalling the main lines through Jhansi, Saugor, Kalpi, and Lalitpur; whilst Rs. 75,000 have been spent on the road from Banda to the East Indian Railway Station of Manikpur, and Rs. 1,30,000 on the Chandrawal and Lakheri bridges. It is gratifying to learn, by way of a *quid pro quo* that "the Boards in return have freely

accepted their responsibilities in respect of the large sums placed annually at their disposal." What is the meaning of "responsibilities?" Why is Bundelkhand, in the matter of communications, admittedly "backward?"

Here is a somewhat sonorous, but interesting paragraph: "With the completion in 1883-84 of the Rohilkhand and Kumaun Railway connecting Bareilly with the foot of the Naini Tal range of hills, the construction of a cart-road communication between the important military hill stations of Ranikhet and Almora and the Railway terminus at Kathgodam became important. The surveys for the road were put in hand in 1883, and a complete project was prepared during that year. The estimate was Rs. 6,90,000, of which the Government of India consented to contribute three lakhs. Work was started in 1883, and up to September 1887, Rs. 5,41,000 had been expended. The only work of importance remaining to be done is the bridge over the Kosi at Ramgarh, of which all the steel work has been received from England, and will shortly be at site. This should be completed during the year 1888, when there will be through communication for wheel traffic over the entire distance of 36 miles. This road will not only place the troops at Ranikhet and Almora in connection with the Railway, but must benefit Kumaun generally, by greatly facilitating the export of tea, fruit, and other valuable products from the interior of the hill districts."

Two big bridges have been constructed during Sir Alfred Lyall's term of office, (1) the combined road and railway bridge over the Kichcha River, on the Bareilly and Naini Tal road, at a cost of Rs. 1,79,000, and (2) a bridge of a similar class over the Desha river on the Bareilly-Pilibhit road, at a cost of two lakhs of rupees. A steam ferry across the Ganges at Ghazipur was also inaugurated. Then we come to the inevitable eulogium on the Muir College. Cost of it Rs. 6,80,000.

Under the heading *Archæology* we are informed that "the most interesting works are those connected with Archæological conservation," and thence we drift to an attempt at an artesian well at Agra, operations on which were commenced in June 1884, and seem unlikely ever to be finished. The experiment will probably be resumed, we are told, "under more favorable conditions at Lucknow."

The Roorkee Foundry, which became the property of the N.-W. P. Government in 1871-72, has been a source of fair profit to it. *Ergo*, the N.-W. P. Government wants to get rid of it. Under the sanction of the Government of India negotiations, which proved inconclusive for its sale, were entered into with a syndicate at Bombay.

Central jails have been completed under Sir Alfred Lyall's auspices at Allahabad, Bareilly, Benares and Fatehgarh at a total cost of twenty lakhs of rupees. Setting Lokil Sluff on one side, these are the main triumphs of Sir Alfred Lyall's tenure of office. What is your duty? Goethe once enquired of himself, and his always self-centred satisfaction with himself was not long kept waiting for a reply. Goethe said promptly, himself to himself—"Your duty is to fulfil the claims of the day." That is what Sir Alfred Lyall seems to have done, with a somewhat to be admired reflection of success on his escutcheon.

Notes and Comments.

NEW MEMBER OF COUNCIL.—Sir Charles Elliot, Public Works Minister, has taken his seat as an ordinary member of the Governor General's Council.

THE SUKKUR BRIDGE.—Work on this undertaking is actively progressing. The bridge has already begun to project over the river from the Sukkur side, and the Engineers have commenced operations at Rori.

NEW YEAR'S DAY HONOURS.—We find that the claims of the Profession have been further recognized in the appointment of Mr. Frederick T. G. Walton, Engineer of the Dufferin Bridge at Benares, to be a C. I. E.

GROUNDING OF A STEAMER.—The "British India" Steamer *Almora* went aground near the James and Mary shoal in the Hooghly last week close to the wreck of the steamer *Arcot*. She floated off the next day without having sustained injury.

PROGRESS IN NORTH BORNEO.—Mr. Fred. Boulton, C. E., has gone to Sandakan, British North Borneo, to erect steam Saw Mills there for the British Borneo Trading and Planting Co. Ltd., who propose developing on a very large scale the timber resources of that country.

BENGAL P. W. SECRETARIAT.—As already announced, Mr. Spring goes back to the Government of India, and speculation is rife as to who will succeed him. It would appear, however, that Mr. F. R. Upcott has the best chance of obtaining the vacant Under-Secretaryship.

COLLEGE OF ENGINEERING, MADRAS.—The following is a list of the successful candidates at the Competitive Examination for admission to the Civil and Mechanical Engineer classes, held on 5th December 1887. The names are placed in order of merit:—A. V. Ramalinga, B.A., K. Gopala Aiyar, G. Panchapikessa Aiyar, A. Rajam Aiyar.

PROPOSED NEW ROAD IN CALCUTTA.—At a recent meeting of the Calcutta Corporation, the motion against taking a strip of land on the frontage line of the proposed new central road from Hooghly Bridge to Sealdah was defeated and Mr. Cotton's amendment was accepted. The matter will ultimately go to the High Court.

THE SIND-PESHIN RAILWAY.—The *Bombay Gazette* declares that inquiries, which have been made during the past few days, mainly in regard to the supply of railway stores, confirm the impression that, despite the confident statements which have been made to the contrary, the Sind-Peshin Railway will be carried to Kandahar at no distant date.

THE HINDU HOSTEL, CALCUTTA.—The superstructure of this building has now been taken in hand. It is to be a three-storied structure, and it is expected that the work will be completed up to the first-floor level by the end of June. Messrs. Bestic and Gwyther have been appointed Engineers to advise the Building Committee during the progress of the work.

A MINING DIRECTOR.—It has been ascertained that Colonel G. B. Malleon, C. S. I., the Director of seventeen mining and other companies, holds but one share of the value of 4s. 6d. to 5s. 6d. in the Maisur Wynaad Company of which he is a Director. The *Mining Journal* understands on excellent authority that he will be requested to resign several of his directorate positions immediately.

A WELL-EARNED HOLIDAY.—Mr. Walton, Executive Engineer, Municipality, Bombay, having been suffering for some days past with typhoid fever, and in a preca-

rious state of health, has obtained privilege leave for three months. Mr. Walton, had not availed himself of his privilege leave for several years past and the Council did well, therefore, in granting him the indulgence asked for.

AN ENGINEER'S ALMANAC.—We have received from Messrs. Macknight, Anderson and Co., of Fairlie Place, Calcutta, the local agents of Messrs. George Angus and Co., manufacturers of leather and india-rubber goods, a small pocket-book purporting to be an almanac for 1888. It is really a handy form of trade catalogue with the addition of some information likely to prove useful to those interested in the firm's specialities.

SEEBPORE ENGINEERING COLLEGE.—Mr. Slater and the 4th year's class have returned from their winter tour, after having inspected various works completed and in progress, and going over the loco-workshops of the E. I. R. at Jamalpur. Mr. Downing is at Muddapur, taking the 2nd and 3rd years' students through their surveying course, and will return at the end of the month. The Mechanical Engineer apprentices' entrance examination was held this week.

A GOOD EXAMPLE.—A Singapore paper which has all along urged the necessity of having a competent Inspector of Buildings attached to the Municipality, is glad to hear that with the introduction of the new Ordinance such an official will be provided for. From the Municipal Engineer's monthly report, it will have been noticed that there are on an average some 600 or 700 new houses under construction over which the new official will have more than he can do to exercise a continuous supervision.

MINERALOGICAL VARIETY IN THE METALLIFEROUS ROCKS OF INDIA.—Mr. F. R. Mallet says that most, at least, of the known copper ores of India occur as a constituent of schistose rocks, and not in lodes, the depositories in Europe of such numerous minerals and magnificent crystals. The Baraganda copper mine, in Hazaribagh, may be cited as a case in point. Although now opened out to a depth of 300 feet, and giving a promising yield of copper pyrites, nothing else has been obtained of any special mineralogical interest.

NEWS FROM THE PHILIPPINES.—The construction of the railway from Manila to Dagupan has been delayed in consequence of a difference of opinion as to the preliminary operations. The bridges to be built along the route prove to be the stumbling block. Some prefer their buttresses to be of brick, thereby necessitating extensive hydraulic operations. Others give the preference to the tubular form now common enough in Europe and America, and offering as many securities for safety as the other system. The company which has taken over the railway contract, favours the latter alternative as most in accordance with the march of improvement.

"LOCAL AUTHORITIES LOAN ACT, 1888."—The Select Committee appointed to consider the Madras Bill to empower local authorities to guarantee interest on, or to create a fund for repayment of, capital expended on certain purposes, report that they have considered the Bill referred to them and have introduced an amendment, the effect of which is to limit the interference of the Governor in Council by attachment in event of default to cases where an application for such interference is made by a party interested. In other respects they have not found any change necessary, and consider that the Bill may be taken into consideration and passed into law forthwith.

INVIDIOUS DISTINCTIONS REMOVED.—The domiciled European, if what are believed to be the recommendations of the Public Service Commission prevail, will hereafter cease to be a semi-proscribed individual. He will be free to compete for every appointment which is open to his neighbours, irrespective of caste or creed. Indeed the principle that Government should be allowed to engage the best workman it can get at the best, that is to say the lowest, price, wherever he may be found, is very distinctly, as we have reason to think, affirmed in the Commission's Report. In view of this the difficult and invidious discussion about the proportion which the pay of a native should bear to that of a European for doing similar duties, is disposed of.

ACQUISITION OF LAND BY PUBLIC SERVANTS.—The reason assigned in one of the Crown Colonies for prohibitory measures *re* land-jobbing on the part of officials is that "greater efficiency may be expected from an officer, whose whole energies are devoted to the public service, than from one whose mind is occupied with the cares and anxieties incident to the possession and cultivation of land," and that "the man who is content to look for advancement solely to his official occupation, has a stronger claim on the public and on his superiors, than one who seeks to combine with it the pursuits of a landed proprietor." The members of the public service are further reminded that a similar restriction for similar reasons has been placed upon them as regards entering into commercial pursuits.

MECHANICAL ENGINEERS FOR THE ROYAL NAVY:—The new rules for engineer students about to be introduced by the Admiralty, appear likely to improve their position, and will also prevent students from obtaining an education at the expense of Government, and then employing it elsewhere. Under the present rules engineer students are apprenticed to the Chief Engineer of the dockyard for six years, after which they go through a course of higher mathematics at the Royal Naval College at Greenwich. But now that the apprenticeship, as such, is abolished, and the engineer students become naval cadets when they join the Marlborough, they become naval officers, subject to naval discipline at once. Recognizing, as we do, the growing importance of naval engineering, we welcome any change that is likely to improve the status of the engineers.

THE HIGHWAYS OF ASIA.—Mr. Thomas Stevens, in describing his bicycle tour of the world, says that the best roads found by him were in British India. One of these highways, known as the Grand Trunk Road, extends for 1,600 miles, from Peshawur, on the Afghan boundary, to Calcutta, "an unbroken highway of marvellous perfection." This excellence Mr. Stevens ascribes to the peculiar substance used for metalling, a material known as *kunkah*. Mr. Stevens says that next to Indian roads, in point of excellence, come those of Japan, and the 800 miles of Japanese roads traversed by the traveller on his bicycle were found excellent throughout. The Japanese highways are made of broken stone and gravel, or disintegrated granite, and in some places are paved with smooth, matched boulders. China has practically no roads at all, as we understand the term.

TONNAGE OF THE PORT OF CALCUTTA.—A statement prepared and issued by a well-known Freight Broker, gives some interesting particulars regarding the Steamers and Sailing Vessels, entered inwards at the Custom House, Calcutta, from 1st January to 31st December 1887.

From this we find that the total number of vessels for 1887 was 1,010, aggregating 1,556,683 tons as compared with 1,035 vessels and 1,523,504 tons in 1886, being 25 vessels and 33,179 tons less than in 1886. Comparing 1887 with 1883, the figures clearly indicate the increasing size of the Ships and Steamers frequenting this Port; in 1887 the number of vessels was 1,010, representing 1,556,683 tons, whereas in 1883, the number of vessels was 1,106 of 1,435,297 tons only, shewing that notwithstanding a reduction of 96 in the number of vessels, the tonnage of 1887 was actually 71,386 in excess of 1883.

OUR RANGOON ITEMS.—A. Correspondent writes:—Lieut Hunter, R.E., Assistant Engineer Military Works Department, is to be transferred to Burma for employment under the Executive Engineer Rangoon Division in the construction of Chowki Point Battery. It is rumoured that work on the Rangoon Cathedral will soon come to a stand still for want of funds. The Executive Engineer, Rangoon Municipality, has asked if the Port Commissioners approve of the proposed sewage outlet, and whether work can be commenced at the outlet at once. But the Port Commissioners wish to know whether there is any objection to the outlet pipe in question being laid below the bed of the river, as they think that silt will accumulate along the foreshore in this locality if the proposed laterite bank is constructed. The new machinery for the Brooking Street wharf shears is expected on the 13th instant.

ADVANCE, MADRAS!—The capital of the benighted Presidency, which is as yet unlighted by gas, is likely to have electric tramways before long. We understand that arrangements have been made in London to supply the city of Madras with a tramway system on the new principle. The acceptance of the offer of the Indian Tramway Syndicate of London, by the Municipality is said to provide for the new motor. There can be little doubt that electrical tramways are specially adapted to the wants of India, where steam or horse power can only be maintained by a relatively heavy expenditure. The chief obstacle to the general substitution of electricity on the existing lines at home is the considerable outlay at starting, coupled with the sacrifice involved in the sudden disposal of the old resources. But where new lines are being laid the electric motor is almost certain to be introduced, its advantages, in point both of efficiency and economy, having been clearly demonstrated.

THE BLOCK IN THE TELEGRAPH DEPARTMENT:—In the Resolution published in October last, Government professed a sincere desire to clear the block in the Telegraph Department by facilitating the retirement of the senior officers on special pensions. The profession may have been sincere; but it is already tolerably certain that the Government scheme for clearing the block is not likely to effect its purpose. The Resolution laid down that, all officers who had 18 years' service in October last would have the privilege of retiring on special pensions provided they did so before the 1st April next. Unfortunately many of these officers will have nearly but not quite completed 20 years' service on the date named, so that were they to retire they would, though gaining the special pension, lose the full ordinary pension for which they had nearly qualified. It seems hard that many of the officers in the Department should be placed in the dilemma of having

to chose between giving up their full 20 years' pension, and losing the special pension granted under the Resolution.

SINGAPORE DEFENCES:—We learn that Major H. E. McCallum, Colonial Engineer to the Government of the Straits Settlements, has been at last successful in his efforts to wrest from the War Department a positive promise to supply adequate guns for the armament of Singapore. Some time ago it was arranged that several batteries should be erected for the protection of this important British position, and the Colonial Government agreed to defray the cost of laying out and erecting these batteries, whilst it was a distinct arrangement that they should be armed when completed, at the expense of the Imperial Government. With this understanding £100,000 was actually spent in throwing up earthworks and constructing forts in Singapore. But when they were completed, the question of armament remained to be considered. The War Department generously offered an assortment of the obsolete 7-in. Armstrong breech-loaders and "converted" 64-pounders which encumber the parapets of some of the fortified positions in the United Kingdom!

THE JETALSAR RAILWAY.—On the morning of the 30th December last the Governor of Bombay proceeded by special train to Jetalsar for the purpose of opening the Jetalsar branch of the metre gauge railway from Jetalsar to Port Veravul, which covers a distance of sixty-seven miles. Up to the present, the work is completed only a few miles further than Choki, but His Excellency, having opened the points, proceeded to that station; where there was the usual decorative celebration. In his opening address H. H. the Nawab Saiheb's brother said:—"There is one thing, however, connected with this ceremony which we must all deeply regret. I refer to the unexpected and lamented death of Mr. Dangerfield, who last year assisted at the turning of the first sod, and who in matters connected with this undertaking, gave me his warm and consistent support. His place so sadly vacated has been ably filled by Major Gardiner, to whom and to Mr. Knox my acknowledgments are due for their skilful management and for the rapid manner in which they have carried through their important work."

PAY AT PAR.—The ways of the India Office are sometimes mysterious, its dealings as dark as its corridors. It keeps on sending the flower of English youth to India, with emoluments diminished by over a third, owing to the fall in exchange. To any proposal from India that the pay of a new appointment, should be fixed with due regard to the present value of the rupee, the India Office turns a deaf ear. It is even inclined to think that existing salaries are too high. Lastly when the Uncovenanted Service represent that their pensions should be raised, because the value of the rupee has fallen, the officials of the India Office, who draw pay and pension in sovereigns, smile like the gods on Olympus. And yet when it was a question, the other day, of sending lady nurses to India, an elaborate calculation was made to guard them from any loss by reason of a depreciated currency. Each lady superintendent, by the way, is offered Rs. 400 a month to begin with, and free quarters. The members of the Uncovenanted Services should get their friends in Parliament to ask why nurses are treated so much better than Engineers.

FRESHES, OR RISE IN RIVER WATERS.—Disastrous floods

have destroyed a fair that was held at Sreerungum in the bed of the river Coleroon, near Trichnopoly last week, at which were exposed for sale large quantities of agricultural produce and over ten thousand bullocks. It had been raining previously, and on the day of the mishap the centre of the river bed contained water only a foot deep. In the evening a great rush of water came down the river sweeping away every thing left in its way. The people in wild confusion and excitement rushed to the higher ground at the banks, and it is believed that all managed to reach places of safety, but a large number of cattle and property were washed away. Discussing the use of telegraphs on the Yellow River for the purpose of conveying news of the rise of the waters at certain parts to places lower down, a Shanghai contemporary says that by this means the authorities would know when to expect a flood, and take the most prompt and decided action. The advantage of this telegraphic information would be incalculably great if simple remedial measures be adopted, and if adopted, faithfully carried out.

RAILWAY ACCIDENTS.—The infrequency of railway accidents in India is remarkable in view of the peculiar risks to which railways in this part of the world are exposed. This, observes the *Englishman*, is brought out clearly by last year's experiences in Bengal. Thus a signal hut was attacked by dacoits, and one of the men on duty was much hurt, while the others were driven from their post. Out of fourteen persons convicted for trying to upset trains, ten were small boys who put stones on the rails for the pleasure of seeing them crushed by passing trains. Nearly a thousand spikes were wrenched from their places on the permanent-way and carried off by thieves; yet evidence to secure a conviction could only be obtained against six persons. A large percentage of the fatalities on English railways, apart from disastrous collisions, occur among the servants of the companies, but in India the casualties among railway servants are greatly outnumbered by fatal accidents to the foolish people who persist in walking sleepily along the line in front of moving trains or loitering ahead of trains at railway stations. Out of 107 persons killed on the railways of Bengal last year, only 29 were railway servants, while most of the others belong to the outside category.

FORESTS AS PROTECTION AGAINST FLOODS.—The *Englishman* asks:—"Are forests on the slopes of hills in India any protection against the flooding of rivers?" and then goes on to say:—"It has hitherto been commonly believed that they were, and the absence of timber in many places has been greatly deplored. But Mr. H. G. Turner, the Agent to the Governor-General in Vizagapatam, has come forward to deny the truth of this accepted theory, so far at least as many parts of the Madras Presidency are concerned. In the many jungles on the hills which Mr. Turner has visited he has never seen a single spring of useful dimensions issuing in the hot weather from the hillsides in Southern India. Rivers in that presidency almost invariably have their origin on plateaux and in sloping valleys, and are formed by the gradual off-flow of the rainfall of the country. All we can say is that, while this may be true of Madras, it is equally true of the hills in some parts of Northern India that the water rushes down the hillsides very much as if they were corrugated-iron roofs. Torrents and floods are thus formed, and to the hills we must look for the secret of the disasters by

which communications are annually cut off, and the Government of India at Simla is left suspended in the predicament of Mahomed's coffin. Madras it seems, is more fortunate."

SANITARY COMMISSIONERS.—In coming to the conclusion that it would be inexpedient to combine the offices of Sanitary Commissioner and the Principal Medical Officer in the various provinces in India, His Excellency the Governor-General in Council nevertheless considers that from evidence collected while considering the matter in consultation with Local Governments, the fact is disclosed that Sanitary Commissioners have not invariably shown themselves as active in the performance of their duties as the Government has a right to expect them to be. In some cases they are permitted to spend time in the hills which should be employed on inspection duty in the plains; and Local Governments have been enjoined to insist on greater activity on the part of these officers. The maintenance of the appointment of Sanitary Commissioner has been decided upon mainly with regard to the necessity of ever-increasing activity and efficiency in the work of the Sanitary Department. His Excellency has left it to the consideration of Local Governments whether the work of Sanitary Commissioners might not be more efficiently discharged, if younger officers were selected for the appointment. In this connection it is suggested that the terms of the appointment, which tend to confine it to rather senior officers, might be examined and the question of the salaries to be attached to these posts also reconsidered.

WOOLWICH CADETSHIPS.—The requirements of the Ordinance Corps have led the authorities to offer 120 Woolwich Cadetships at the competitive examination which commenced the week before the last mail left England. It has been determined to pass out from the Military Academy two classes instead of one at the end of the present term, and it is to make good the deficiency thus caused that the extra cadetships are to be given. Two years ago additional officers were in the same way urgently wanted, but instead of reducing the number of the terms of the Woolwich course, from four to three, as is being done on this occasion, the vacancies in the establishment were filled by the offer of a number of direct commissions, while the progress of the cadets through Woolwich was accelerated by shortening the terms and the holidays, so that five batches of cadets instead of four were brought forward for commissions within two years. Previously to this, when an augmentation of the Royal Engineers had rendered the appointment of additional officers a necessity, the deficiency was made good by recruits from the Indian Engineering College at Cooper's Hill; from the Military College, at Kingston in Canada; and from the Colonial Universities. Forty appointments were appropriated in this manner. But the offer of direct commissions caused great discontent at the Academy, and it was determined—in fact a kind of pledge was given to the effect by the Secretary of State for War when the question was raised in the House of Commons—that, if hereafter more officers were wanted than the ordinary output of Woolwich could supply, the requirement should be met by passing out cadets before they had put in their full two years at the Academy. This is how it comes that 120 Cadetships are offered to the public this winter. And if 120 qualified candidates are forthcoming, it is the proper course to adopt.

Current News.

LIEUTENANT F. BAYLEY, R.E., has been posted to Rangoon, on Sub Marine Defence duty.

THE NEDORE-THIRUPATI section of the South Indian Railway, a length of eighty-three miles, is now open to traffic.

MR. JOHN PENDER, who has received the C. M. G., is the well known promoter of international telegraph communications.

THE new Viceregal Lodge at Simla is to be lighted throughout by electricity, nearly a thousand glow-lamps being employed.

THE mineral wealth of Upper Burma has not been long in attracting attention. Applicants have already sought leave to prospect for gold and coal.

MR. G. D. BURGESS, Commissioner of the Northern Division, Upper Burma, accompanies Mr. Brown, the English Geologist, on his visit to the Ruby Mines.

THE Cawnpore-Jhansi section of the Indian Midland Railway is to be opened definitely on the 1st February, when the Company also take over the working of the Bhopal State line.

AT their last half-yearly meeting the shareholders of the New Beerbhoom Coal Company had the good sense to vote a bonus of Rs. 1,000 to the directors. It was well earned.

TO show how safe the Government must consider the road to Katmandoo, Mr. W. Christie, Executive Engineer P. W. D. from Hazaribagh, has been sent up to Katmandoo to inspect the Residency.

ABOUT a score of new appointments have, we believe, been recently sanctioned by the India Office for the Forest Department in Upper Burma, but not more than three-fourths of the number will be filled at present.

THE work at the Kidderpur Docks is advancing steadily. Considerable additions were made to the walls of the basins during the past month, an army of nearly 10,000 labourers being employed daily on the works.

COLONEL G. C. L. S. SEAFORD, C.B., R.E., Inspector-General of Military Works, has arrived in Calcutta on duty in connexion with fortifications. He lately conducted, with other officers, an enquiry into the state of the so-called defences of Madras.

THE services of Mr. A. R. Macdonald, Assistant Engineer, First Grade, State Railways, employed under the Bombay, Baroda, and Central India Railway Company, have been placed at the disposal of the Foreign Department for employment in the Gwalior State.

ON a recent reference from a local Government regarding the question of the source from which explosives for use in India should be obtained, the Supreme Government has ruled that it is on the whole preferable to purchase them locally in India as occasion may arise.

THE Irrawaddy has fallen extraordinarily, the Nazum rocks below Sagain having so little water on them that steamers cannot pass. There is, moreover, no prospect of a rise in the river until March. Engineers have been sent to see what steps can be taken to blow the rocks up.

THE Irrigation Board of Hyderabad seems to be getting to work. At their last meeting they had plans and estimates for the repair of the Tanakulla tank in Indur which gave way in the 1886 rains. The area irrigated from this tank was 194 begas. But the expectations of the Engineer of the district are still higher, for he estimates that when repaired it will irrigate 600 begas.

JUDGMENT has been delivered at Simla in the suit of the Allahabad builder Johnson *versus* the Secretary of State. The Court held that misrepresentation had not been proved, and dismissed the suit for all claims in the shape of extra rates, but decreed Rs. 773, excess debited by plaintiff to defendant, and Rs. 1,645 as due instead of Rs. 964 paid into Court by defendant. The total amount decreed is Rs. 2,467.

THE following curious telegram from Mandalay, dated Saturday last, appears in an up-country paper:—"Mr. Crawford, Supervisor, Public Works, and five contractors, natives of India, await their trial in Shwebo Jail of conspiracy to murder Mr. Simpson, Executive Engineer, Shwebo, on the way to Kyoukmyoung on the river bank. Fortunately the plot was discovered through the agency of an office peon."

THE residents at Karachi, says a home paper, do not seem inclined to let the question of railway extension from that port drop out of sight, and they are able, in one respect, to take up a strong position. The original blunder made by the Indian Public Works Department in its estimates of their proposals, allows them to argue that the proposals were carelessly prejudged; and to enlist public sympathy against official negligence.

THE Tavancore Government has entered into an agreement with Messrs. Wallibhoy Kaderbhoy and Co., of Bombay, for digging plumibago, which abounds in many parts of the State. The Company is to have the monopoly of digging the mineral for twenty years. For the first ten years it is to pay the Government Rs. 2½ for every ton of plumibago taken, and for the remaining ten years the rate is to be Rs. 5 per ton. The Company is to begin mining

operations in the two taluks of Nedoovngad and Sherayingil within three years from date.

Letters to the Editor.

[The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

TRUTH STRANGER THAN FICTION.

SIR,—An up-country paper lately asserted that Colonel Dodd has returned from leave, and resumed charge of his duties as—Superintendent of the Government Press at Allahabad. I do not know what Regiment has the honour of bearing Colonel Dodd's name on its rolls as an absentee, qualifying for Colonel's allowances in a printing office. But I do know that constant complaints are made about regiments being short of their complement of officers; and I fail to perceive in the condition of the body politic any such urgent necessity for printed matter from a Government Press as should compel an officer and a gentleman, a Colonel without even the excuse of Subaltern pay, to affiliate himself to the mechanical art of printing, and take the bread out of some poor man's mouth, as the homely saw puts it. In its way it is just as bad form as the Duke of Connaught's command of the Bombay army, or the Duke of Edinburgh's command of the Mediterranean squadron. SPERO MELIORA.

INDIAN ENGINEERING QUALIFICATIONS.

SIR,—It is contended that the Examiners of the Calcutta University for Licenses and Degrees in Engineering should be P. W. D. Officers, and the only reason alleged for this is found in the fact that these University qualifications are indispensable for admission into the P. W. D., Bengal. Surely the only office of the Seebpore Engineering College is not to train men for that single purpose. I think that its object is to train men for the Profession. The P. W. D. should have its own tests, and the scope of the University should not be hampered by restrictions intended to meet the wants of an isolated branch of the public service. In Madras the University Examiners are non-Government Engineers, and I believe that the same practice obtains to a great extent in Bombay. I would suggest that the P. W. D. should specially train those passed students, whom it may select for its requirements, and not handicap those who may not have occasion for Government employ. This view of the case is further strengthened by the fact that no matter from whatever source the man who joins the P. W. D. comes, he has to still further undergo Professional and Language Tests before he can expect advancement in the service.

A SUFFERER.

INDIAN COAL FOR OCEAN STEAMERS.

SIR,—The ever recurring question why Indian Coal cannot be placed at the various markets of India and the coaling stations along the Malay-Chinese Peninsula at a rate to compete with the Australian and English Mineral, has come up once more for attention. The reported discovery of Coal in Kali on the Chindwin River in Upper Burmah, the gradual development of the Assam Coal fields, the last deposits of Sumatra and Borneo, and the gradual though sure supersession of the English Mineral by the Indian material emphasises the importance of the question, in a degree that it can no longer be dismissed with that indifference which until now had its origin in prejudice and in the imperfect estimate made of the comparative value of the Indian mineral. The axiomatic proposition that Bengal coal is to the English fuel, as $\frac{2}{3}$ to 1 will no longer find adherents when it is stated that nearly all sea-going and inland steamers are at the present moment using no other but the Bengal coal. Until recently the P and O Company was standing out in strong relief as the only exception to the general rule, but it has now thought it opportune—perhaps advantageous—to enter the arena, notwithstanding the fact that extra bunker room would be needed were the proportion above referred to, correct. It is hardly likely that a Company like the P and O would sacrifice tonnage equal to the difference between the two coals in the face of the exigencies of competition which demand the economy of the smallest available cargo room. The question then very naturally presents itself whether the coal now placed in the market, has improved from being obtained from deep workings or that the article is the same now as it has been for many years past. I am in a position to declare that were it not the keen competition which has dulled the feeling of prejudice which could or would accept nothing that was not English, and experience which has conclusively proved that some of the Bengal and Assam coals are as good as the average of English coal which has for the past many years found its way into the Indian markets for steamers, the same bias or objection to the use of Indian coal would continue for an indefinite period. Assam and Bengal coals are now in great request and have already secured large orders for purposes of steamers and manufactories; and if things continue to proceed as they have commenced, it will not be long before all steamers homeward or outward bound, from most of the important ports of this country and those of the Malay Peninsula and the Dutch East Indies will be using almost exclusively coals from India.

AN INDIAN COLLIER.

Literary Notices.

SPECIFICATIONS, RATES AND NOTES ON WORK, COMPILED FOR THE USE OF THE P. W. DEPARTMENT IN THE BOMBAY PRESIDENCY. By Captain E. L. Marryat, R.E. 1st and 2nd Editions, and Lieutenant-Colonel B. R. Seton, R.E., 3rd and 4th Editions. Bombay: Government Press. 1887.

ENGINEERING construction in India, particularly as regards buildings, differs so much from the types which obtain in Europe, that a good special treatise dealing with Indian professional practice in all its branches is a great desideratum for purposes of reference or instruction to all engaged in the vast Public Works of this country.

We already possess certain compilations of the kind which aim at being text books on Indian technical matters, but as a rule they fall far behind a very moderate standard of efficiency. The principal of these is the well known Roorkee Treatise, with its three ponderous and expensive volumes of mostly obsolete matter. We do not, however, propose to refer any more at present to that antiquated production which draws its inspirations mainly from Mahan's Civil Engineering, published in the beginning of the century, but will pass under review a modern work, issued a few months ago by the Bombay Government Press.

We refer to "Specifications, Rates and Notes on Work," compiled by Lieutenant-Colonel Seton, R.E. The nucleus of the volume in its present form was the first edition published many years ago, and popularly known as "Marryat's Specifications." The scope of the present fourth edition is very much enlarged, and embraces, not only standard specifications of all kinds, but a series of estimates completely drawn out of various descriptions of roofs and road bridges. Besides this, a great deal of more or less useful information of a practical nature is given in the "Notes on Work," and a number of excellent wood-cuts illustrate the text.

Engineering, like medicine, is a distinctly progressive science. Old and once favored types of construction become superseded by others, whose superiority in durability and cheapness is incontestable. One would naturally think that a work published as late as the year of grace 1887, and under the imprimatur of the Government of Bombay and edited by a Colonel of the scientific corps would contain all the latest improvements in the construction of buildings and bridges. A careful inspection of the volume under review, however, reveals the fact, that with the exception of one short chapter on blasting with dynamite, and another on the use of concrete arches, there is absolutely nothing that may not be found in ancient treatises published at a time when scientific knowledge in the Profession was generally at a low ebb, and when Engineering works of reference were scarcely obtainable. In addition to the almost entire lack of mention of well known improvements, we find that some obsolete and long abandoned types of tiled roofing are carefully reproduced.

The old wooden frame tile roof, (king post and queen post,) etc., here, as in the Roorkee Treatise, again confronts us with unwearying pertinacity, and several descriptions of tiling with illustrations, all of which are of a type now long since passed into the limbo of the forgotten past, are brought forward with the most unblushing effrontery. While on this point we will take it up in detail.

The tilings mentioned are—1st.—Taylor's patent tiles, pages 174 and 175. We have never seen this system, but it may possibly have been used in Bombay.

It is extremely complicated and requires most careful fitting and is after all only single tiling, and is thus solely applicable to out-houses and warehouses. The battens are 3" x 1", 10 inches apart, thus necessitating a very close arrangement of purlins and a great deal of woodwork in the frame.

2ndly.—We have the Mangalore tiles, page 177. These are lock tiles, similar to Frizzoni's Allahabad tiling, but with several points of inferiority. By some unaccountable omission, only single tiling is illustrated.

3rdly.—Goodwyn's and Atkinson's tiles, which follow, are both

ago by the well known double Allahabad tiling, with which most of the barracks and Government buildings in the N.-W. P. and the Punjab are covered.

4thly.—"Hill's" tiles are nothing more or less than the "Allahabad" system. The author, from the text, is apparently totally unaware of this fact, and treats the system as if it were quite a new and untried invention; he further states, that the flat tiles should be laid in mortar, whereas one of the main advantages of the system is, that cementing material is entirely dispensed with except in the eaves. Information regarding the weight of tiling, which to the ordinary reader would appear a matter of some importance, is not to be found anywhere, but is left to his unaided imaginative powers. The required spacing of battens and purlins, instead of being shown in a proper tabular statement easy for reference, can only be discovered by a diligent search among foot-notes printed in italics. In the examples given of iron framed trusses, information regarding the required section of iron purlins, which are usually substituted for wooden battens, is for some unaccountable reason entirely omitted. It is equally or more incomprehensible why the use of scrap rails for rafters, which can be adopted for double tiling up to 40ft. span without trussing, is not even hinted at, although there must be numerous examples of this on the Bombay side, at least on the railways.

The ignorance displayed as to the new forms of tiling, some of which have been in use in the P. W. Department for nearly two decades and, others which are of more recent origin, is positively astounding. Bull's, Burn's, Frizzoni's lock, and even the very old-fashioned and superseded Allahabad tiling receive no notice whatever. The gallant author, if at all aware of these things, must be congratulated on the extreme dexterity with which he has concealed his knowledge from the interested public.

"Fireproof flooring and roofing," which is incidentally touched upon, consists of rolled iron beams at uncertain intervals with cross joists of T.I. spanned by flat tiles—a most expensive arrangement; and another style of construction termed "Arched terracing," which is jack arches and rolled beams, is also casually noted. But we can get nothing about this, except some very bare facts. A tabular statement giving the proper sections of rolled beams for different spans, the most economical spacing, would have been of real use. Whereas the pages and pages of plates and estimates of old-fashioned wooden hip roofs are of no practical value at all, except for the purpose of thickening the volume. The subject of arch tied roofs, which have been used in the Bengal and Madras Presidencies for the last 10 or 12 years, and which forms the most important and valuable modern improvement on the old perishable wooden roof, is passed over with ominous silence. We fear that the compiler will only be able to plead in Dr. Johnson's well known words, "Crass ignorance, Sir; crass ignorance."

One chapter, as we have already observed, is devoted to the subject of concrete arching. This is put forward as a great novelty and certainly the method of tying the spans is amusing as an example of as clumsy and expensive an arrangement as the folly of man could well conceive. We do not see the object of using concrete for segmental arch roofs. Brick is undoubtedly a cheaper material, and much more suitable in every way. Besides the timid constructor puts ten feet as the limit span for this type of work.

It would certainly seem strange to the intelligent foreigner that the Government of this country, with its vast resources in the way of Engineering personnel, a large number of whom are doubtless possessed of high scientific attainments and much practical knowledge, should never be able to produce a single treatise on Indian Engineering subjects that can command the respect of the profession. This new book we have just been reviewing, though it undoubtedly does contain a good deal of useful matter, is still, from the total omission of any notice of modern improved construction, *practically useless*, and all we can suggest is, that the Bombay Government withdraw this 4th edition and issue a 5th, which, properly worked up, would prove a very valuable addition to Indian Engineer-

General Articles.

NEW OFFICES FOR THE MATHEMATICAL INSTRUMENT DEPARTMENT OF THE SURVEY OF INDIA.

OUR illustrations in this issue of INDIAN ENGINEERING, represent portions of the new building in Park Street intended to accommodate the Mathematical Instrument Branch of the Survey of India. This block, which is approaching completion, is the second of a group of three buildings which are to contain the whole of the survey offices in Calcutta. The Head Office is located in the block which stands back, furthest from Park Street overlooking Short Street, and is already familiar to residents and visitors of the metropolis, as one of the prominent red brick buildings which have sprung up under the skilful direction of Mr. E. J. Martin, F.R.I.B.A., and given to Calcutta a more equitable claim to being considered the 'City of Palaces.'

The Mathematical Instrument Office has been designed by Mr. W. Banks Gwyther, A.R.I.B.A., of the P. W. D., and his aim in this instance has been, to preserve a certain degree of harmony with the completed structure already referred to.

The new building consists of two stories, the machinery and work rooms occupying the lower, and the offices, records and stores the upper floor. As regards its construction, the brick work is of Akra bricks, the exterior face being pointed; rolled iron beams are used with brick arching to support flat terrace; the wood-work is of teak, and the ornamentation consists of colored bricks arranged in diaper patterns, and buff terra-cotta, both of which items are being supplied by Messrs. Burn and Co. from their Potteries at Raneeungee.

The elevations herein illustrated,* give only a general idea of the form of the structure and of the nature of its embellishment, but in a line drawing contrasts of color and of light and shade are quite unrepresented.

It is understood that the block to accommodate the Photo-Litho. Branch of the Survey Department, which is to occupy a position intermediate between the two buildings above-mentioned, will shortly be put in hand.

MAIL STEAMERS AND THEIR SPEEDS.

BY A. EWBANK.

II.

To the worthy Admiral it might have been replied that if we wish a ship to be driven by the wind all we want is a mast, and a couple of sails, the ropes, stays, sheets and shrouds are only arranged to mystify the public. However this may be, a landsman can acquire a sound idea of the action of wind on a vessel without being learned in the various parts and uses of the rigging. Similarly, a man untrained in engineering technicalities can form a sound idea of the driving action of steam.

We have stated as a result of theory, that if an engine introduce into the cylinder steam at 150°C , and if this steam after driving the piston through the range of its stroke escapes at 50°C , then such an engine cannot utilise even one-fourth of the power that is latent in coal. The actual fraction that we have described as being less than one quarter may be given approximately as $\frac{1}{22}$, more roughly it may be given as $\frac{1}{25}$.

In the world of non-science the word theory is often used as synonymous with unjustified guess work. "This is pure theory," in that world seems to imply "this is certainly erroneous." Or again we often hear that such and such a thing "is true in theory, but it is not true in practice." If anything is true in theory it must be true in practice, provided all the conditions specified or implied by the theory are strictly observed.

For instance, it was for the first time proved in this Journal by pure theory, that if a cannon ball is fired from a rifled cannon, and is fired in the meridian northwards, the cannon ball will not strike the earth due north of its starting point. Suppose now it happened—as it might happen—that a spinning cannon ball did strike the ground

due north of its starting point. Would this experiment disprove the theory? Certainly yes, if the experiment was made in still air. Certainly no, if there was a strong east wind blowing. In fact, in the latter case the theory would rather be verified. For the tendency of the east wind must have been to carry the cannon ball westwards, out of the original line of fire.

This example illustrates the error into which non-scientific people often fall. They introduce into the supposed experiment additional conditions which conflict with the original set of conditions embodied in the theory. They then discover—as they ought to do if the theory be sound—certain discrepancies between the result predicted by theory, and the result that is reached in practice. They then quote the discrepancies as disproof of the theory. But had there been no discrepancies that would have disproved the theory. Every cause is bound to have its effect.

The statement that a steam engine using steam between 150°C and 50°C cannot utilise more than a certain fraction x of its coal power may be otherwise stated as follows in the form of a notification to the managers of all steam engine workshops. "No matter how carefully and skilfully you construct your engine. No matter how carefully you arrange for the boiler fire to expend most of its heat on the water instead of losing much into the air. No matter how successful you are in conveying the hot steam into the cylinder without its losing much heat on the way. No matter how nicely you have the cylinder of truly circular section. No matter how closely you fit the piston so that steam may not slip in between the piston and the concave cylinder surface. No matter how completely you reduce the friction between the piston and cylinder so as to ordain that the steam power may be expended in really driving the engine with its attendant load; and not be wasted to any appreciable extent in overcoming friction. No matter how in such features as these you make your engine a marvel of cunning geometrical and mechanical perfections, you will still never attain to extracting out of the coal which you shovel into your furnace one-quarter of its latent energy."

This limit applies only to the case when the steam temperatures are 150°C and 50°C .

Whether the engine constructors will succeed in closely approaching that value x —which we will call the "efficiency limit"—is a totally different question on which the theory of heat has no remarks to offer. Theory indicates the absolute limit of perfection. Theory has no means of measuring the limits of human imperfection. It may be assumed that workshops will turn out year after year machines that go on improving—that make continual advances in the direction of that unattainable x .

It may perhaps be objected that if the x efficiency is unattainable there is no use in the theory. Let us try this new objection by a simple illustration. A carpenter has to make a certain number of circular tables with carved legs. He buys his wood in planks of a given breadth and thickness, but of any length that he desires. He calculates the least total length of planking of the given breadth and thickness that he will require provided that neither he nor his assistants make any mistakes, i.e., provided that no one spoils any wood in the process, and provided that all cuttings are utilised as much as is possible, i.e., provided that there is no avoidable waste. Is this calculation useless? Does it not indicate an inferior limit below which his wood purchase must not fall? Having arrived at this inferior limit he then adds such a percentage for waste or accident as his experience serves to suggest.

Similarly, is it not just as well that the designer of an engine which is to work between 150°C and 50°C should not be under the delusion that if the stoker is properly careful of his coal he should be able to expend it so economically as to give an efficiency much greater than that x —say an efficiency of 75 per cent.? Is it not useful in any department of human enterprise—be it what it may—to know the superior limit that defines the utmost attainable excellence?

(To be continued.)

* Two are given in this issue and a third will be produced in our next.—Ed., I.E.

DEODAR *VERSUS* STEEL SLEEPERS.

BY RAI BAHADUR KUNHYA LAL, M.I.C.E.

1. THE most essential properties of timber as a building material, are, *strength, hardness, stiffness, and durability*; *strength*, or resistance which timber offers to rupture, caused either by compression, extension, or a transverse strain; *hardness*, or the capability of timber to resist shocks and attrition; *stiffness*, or that property of the timber which renders it capable of sustaining the greatest weight with the least possible degree of bending; and *durability*, or the power of the timber to remain unchanged, when exposed to the weather. These qualities are generally found in timbers, which are free from knots, and straight-grained, and which on being soaked in water have their weights the least changed.

2. The best building timber in the Punjab is *deodar*, which is obtained in large lengths in the hills. It possesses *strength, hardness, stiffness, and durability*, and is, therefore, well fitted for sleepers on the Railway, entailing less wear and tear to rolling-stock, less breakage of sleepers in case of accidents, and also being much cheaper than other kinds of sleepers.

3. For broad as well as narrow gauge, it is equally good, and is easily obtained in large quantities, at convenient places. Best heart wood should only be used, and all defective wood rejected, it should be entirely free from sap wood, large, and loose knots, flaws, shakes, and splits, and should be well seasoned. *Picked heart wood* is free from the attacks of white-ants, and the ravage of other insects.

4. Timber possessed of the above qualities is found best adapted for the general purposes of Railways, but for sleepers, that timber answers best, which possesses the *greatest stiffness*; for this property of the timber is more essential than mere strength to the stability and appearance of a line of Railway. Besides, for sleepers, timber is never subjected to strains that *absolutely* break them.

5. In selecting timber for purposes of Railway, that which is the most compact, straight and close-grained, perfectly sound, and well seasoned, is to be preferred to that which is the reverse. The most durable and strongest timber is procured from trees which grow in warm and sunny localities, and which are of the slowest growth, and take the longest time to come to maturity.

6. The principal timbers for Railway sleepers ought to be perfectly sound, and clean, and especially about the middle of their lengths, they ought to be free from the least defect. Pieces of timber having large knots in them should invariably be rejected for sleepers.

7. Timber is not used for building purposes when freshly cut, but is allowed to lose its natural moisture very gradually so as to become hard and dry, or what is in the language of carpentry called "*seasoned*." The time required for the different kinds of woods to become fully seasoned, varies according to the nature of the wood, and the size of the timbers. Coarse, open-grained woods, such as mangoe and toon, become sufficiently seasoned for common use within one year, but the dense and close-grained woods, such as babul, ebony, &c., are not sufficiently dry for joiner's work at the end of three years; while *sāl* and *deodar*, which are both coarse-grained, and consist of particularly straight and even fibres, do not become perfectly seasoned, even at the end of eight or ten years.

8. But according to Tredgold, any kind of wood may be considered sufficiently seasoned for common purposes, when it has lost one-fifth of its original weight, and sufficiently dried for joiner's work, when it has lost one-third of its weight. Hence for purposes of Railway, we may use any timber that has lost between one-fifth and one-third of its original weight, without reference to the length of time that has elapsed since it was cut.

9. *Deodar* wood, on account of its superior stiffness, is best adapted for purposes of Railway. This wood consists of particularly straight and even fibres, and is generally free from large knots. It is procured from forests in the

hills to the north of the Punjab, and can be obtained from 30 to 70 feet in length, and from 2 to 5 feet in thickness.

10. *Sāl* is the chief building timber used in the N.-W. Provinces, and a good supply of that description of wood is always kept on hand in the principal timber markets in that part of India. But in the Punjab *sāl* is not readily procurable, and its place is supplied by *deodar*, which, when properly seasoned, ranks next only to *sāl* as a good building timber. The timber markets of the Punjab are supplied with this description of wood from the forests of Jhelum, Chenab, and Ravee. Ravee timber is considered to be the *best* of the three, but *deodar* wood is also procured from the forests about Simla. In the hilly country from Kashmir to Simla, the *deodar* is used, not only for purposes of roofs and doors, but also for building houses and temples; and its durability is such, that temples constructed of it some four or five hundred years back are still existing without any great injury to their external carvings and figures.

11. When sleepers are purchased from markets, or supplied by contractors for the purpose of Railway, only the good, straight, and thoroughly seasoned sleepers should be taken, and all others rejected. For, if timber that is not sufficiently seasoned be used, the sleepers used will shrink in drying after the line has been constructed, and this will render the line shaky and unsafe for traffic. In picking out, therefore, good sleepers from a timber yard, the Engineer should not be satisfied merely with the external good appearance of the sleepers, but should also ascertain their specific gravity, or the weight per cubic foot of the sleeper, and thereby see whether it is sufficiently seasoned for his purpose or not. The weight per cubic foot may be ascertained by having a sample cut out of the piece and weighed, and the specific gravity be found according to the methods given in works on that subject.

12. But the specific gravity need not be determined; the weight of a cubic foot of the wood may at once be compared with the weight entered in tables given in books for that kind of wood, which is about 40lbs. per cubic foot, and if the actual weight is found either to agree with, or be less than, what is contained in the tables, i.e., 40lbs. per cubic foot, the wood may be considered fit for use, but if not, it should be rejected.

13. According to Cunningham, *deodar* of the Punjab is generally supposed to be the same as the cedar of Lebanon, which was used in the building of Solomon's temple, a purpose for which it was eminently fitted by its large size and durability. In Kashmir all the principal buildings are constructed of *deodar*, but the forest* of columns which supports the roof of the Juma Musjid is more remarkable for the vast number and size of the trees than for any architectural beauty. The effect, however is very striking; for, plain as the pillars are, their very numbers and height give a certain degree of dignity, which no ornament could have attained.

14. According to the same author, the *deodar*, when freshly cut, is so full of turpentine as to be quite unsuitable for any kind of in-door work. In the hill stations, where it has not been subjected to seasoning by water, it retains its turpentine for at least ten or twelve years, and perhaps for a longer time. But in the plains of the Punjab, where all the timbers have been floated down the different rivers, they become seasoned by their long immersion in the water before they reach their destination. A prejudice exists against the use of *deodar* for boxes and book-cases, but experience, with both boxes and book-cases, shews that the prejudice is not well founded. It is a fact that Simla book-cases and ward-robcs will stain the books and clothes that are placed in them, but the cause is a simple one, for the Simla wood is never seasoned in any way. When properly seasoned, I say from experience, that there is not a better wood in India

* These pine pillars are nearly four hundred in number, of which about seventy are 49 feet in height, and the rest 22 feet.

for Railway work than the deodar. A number of planks, each three years old, were tested with a washerman's hot iron run over a clean sheet of paper laid upon the planks, which did not become soiled in the least, excepting over the knots of one specimen. But these knots may be generally avoided by selecting the timbers of largest girth. These are generally almost free from knots and give by far the best outturn of clean straight-grained sleepers from 8 to 10 inches wide.

15. I would, therefore, recommend that Railway sleepers, in order that they may be substantial and fit to last for years, be constructed entirely of the above description of wood, in preference to steel sleepers, which are more costly and brittle, being unfit for Railway purposes.

16. Deodar sleepers cost from Rs. 1-12 to Rs. 3-4 each, while steel sleepers cost more than twice as much. The former are therefore in every respect well fitted for Railway work, besides using the produce of the country in preference to European manufacture.

K.L.

LAHORE; October 28, 1887.

KURRACHEE HARBOUR WORKS.

II.

THE history and nature of the improvement works by which Kurrachee has been so far advanced as a safe and convenient harbour, also its further requirements, are now to be briefly described.

Previous to, and for some years after, the conquest of Sind (in 1843), the harbour of Kurrachee was generally considered as barred against the entrance of other than country-craft, though an exception is on record in the case of the two vessels (of a small class, however,) belonging to the H. E. I. Company's Marine, by which, in 1809, the mission headed by Mr. Ellis was conveyed to Sind.

Accordingly, in the early years of intercourse with the province, steamers and ships anchored in the roads, outside Manora Point, and there transferred the troops and stores into boats, by which they were conveyed up the harbour as far as the tide allowed, and thence again transferred in smaller boats to a spot near the site of the present Custom-house, near the native town.

After a time it was found that the difficulties of the bar had been somewhat exaggerated, and that vessels of moderate draught could cross it with safety.

This induced the despatch of ships direct from England to Kurrachee, and the first of these was the *Duke of Argyll*, a vessel of 800 tons, which arrived in October 1852, carrying troops and a cargo of coal and iron. After this the port became better known, and the number of ships steadily increased, though the bar still continued to be a serious drawback.

The first works of accommodation executed in the harbour were the timber pile-pier at Keamari (accessible to native craft and to lighters) and the Napier Mole causeway, two miles in length, connecting Keamari Island with the town of Kurrachee, and the upper part of which afforded a shallow wharfage to native craft.

These works were initiated and strongly urged by Sir Charles Napier, the conqueror and Governor of Sind, but were not completed until 1853, during the Commissionership of Mr. (now the Right Honourable Sir) Bartle Frere.

Both these works greatly facilitated traffic between the shipping and the town, but the mole affected the harbour unfavourably, by cutting off about one-fifth of the back-water space, and by causing accumulation in the creek leading to the town landing-place.

The space thus cut off still communicated with the sea by the "Chinna" creek, the mouth of which became greatly enlarged by the increased scour, and which has been closed as part of the improvement works.

It appears that Sir Charles Napier, from the first, contemplated openings in the mole, which, however, by the advice of his senior Naval Officer, were not carried out; but the want has since been supplied by the opening and iron-bridge already referred to.

Sir Charles Napier also contemplated the deepening of the entrance, besides many other improvements of the place, which time and circumstances did not admit of his carrying out.

Thus, the general question of the harbour improvement was left to be initiated by Mr. (now the Right Honourable Sir) Bartle Frere, aided by the advice of the local Engineers, headed by Major (now General) H. B. Turner, R.E.

A prominent part in the discussion was taken by Mr. Hardy Wells, afterwards the first Chief Engineer of the Sind Railway Company, who, headed by Mr. W. P. Andrew, have throughout warmly supported the Kurrachee Harbour Works.

After surveys by Commander Grieve, I.N., and much local discussion and enquiry, Major Turner suggested a reference, through the Home Government, to some Civil Engineer of eminence in the special branch of harbour works.

It is well to record the public spirit and professional liberality evinced in such a recommendation, by an officer whose position might not unnaturally have suggested to him to keep this important project in his own hands.

The result was a reference to the late Mr. James Walker, who, in 1858, aided by Mr. William Parkes (who visited Kurrachee in 1857-58, to make local surveys and observations) prepared a design, according to which he estimated the improvement of the entrance and harbour generally at £300,000, and indicated the arrangements of basins, quays and graving-dock at a further cost of £360,000, making a total of £660,000, which he recommended "to make Kurrachee suitable for an extensive trade in shipping of large tonnage."

It may here be remarked that since 1858, and specially since the opening of the Suez Canal, both tonnage and length of vessels have so increased in scale, that it can be no matter of surprise if the outlay thus contemplated by Mr. Walker, to be incurred within six to eight years, was afterwards found insufficient.

The works thus designed for the improvement of the entrance and harbour were mainly directed to two objects, viz., to shelter "the bar" from the heavy seas of the S.-W. monsoon, and to direct and increase the tidal-scour in the harbour and across the bar.

Owing to financial considerations, and with the very qualified and reluctant concurrence of Mr. Walker, the sanction by the Secretary of State for India in Council was, in the first instance, confined to the works bearing on scour. This postponement of the breakwater eventually led to greatly increased cost, for it directly checked the full development of benefit from the other works, and thus indirectly also was injurious, as giving a temporary apparent support to objections which were raised during the progress of the works, and, besides great delay, caused their entire suspension for two years (1866-68).

The works were commenced in 1860, under the superintendence of Mr. W. H. PRICE, M. I. C. E., who has, up to the present time, held charge, excepting two periods of leave, during the first of which (1864-65), Lieutenant (now Major) Merewether, R.E., acted for him, and during the greater part of the latter (1874-75) Mr. Hart, M. I. C. E.

Up to 1865, the general direction and control was in the hands of the superior officers of the Public Works Department, under strict orders from Government to adhere to the design of Mr. Walker, who, however, did not long survive the commencement of the works, as he died in 1862.

From 1866 to 1868, as already stated, the works were suspended, though the staff continued surveys and observations; and, in 1869, operations were resumed, on the recommendation (after a conference on the spot) of Sir Seymour FitzGerald, then Governor of Bombay.

From 1868 to 1873, in which year the breakwater was completed, Mr. W. Parkes (who had assisted Mr. Walker in the preparation of the original design) was

Consulting Engineer, the conduct of operations still remaining under the Government of Bombay in the Public Works Department.

Shortly before the resumption of the works, Sir William Merewether became Commissioner in Sind, and throughout his rule effectually and heartily forwarded the harbour works.

In this connection also should not be omitted the name of Captain Edward Giles of the (late) Indian Navy, for several years Master Attendant of Kurrachee, whose valuable opinion and unwavering support did so much to help the undertaking through its gloomiest days.

The general character of the principal works executed will have been gathered from the description of the features of the harbour already given.

These works were all heavy, and in their combined operations constitute a highly interesting piece of engineering; but the breakwater is the only one of them of which the construction presents special interest, when viewed from an European point of view. This work is fully described in a paper read before the Institution of Civil Engineers, but a short account of it may now be given.

The structure consists of a base of rubble-stone (*pierres perdues*) deposited from boats, and levelled off by helmet-divers, generally to 15 feet under low water; and on this base, concrete-blocks, each weighing 27 tons, set on edge, leaning back at a slope of three inches to one foot, and without bond, two forming the width, and three the height, and together making a square of 24 feet in cross section, the top being about the level of high water.

Portland cement, river sand, shingle, and quarry lumps, mixed with salt water, were the materials used for the blocks, the bulk of cement being $\frac{1}{11}$ that of the finished block.

After conveyance from the moulding ground, the blocks were set by a steam travelling-crane, called the "Titan," which (running on rails on its own finished work) does not require staging. This machine was devised in consultation between Mr. Parkes and Mr. Price, and was made by Messrs. Stothert and Pitt, of Bath.

By its means the 1,500 running feet of breakwater was built in three working seasons, aggregating 12 months.

The "Titan" was (with other Kurrachee machinery) afterwards sold to the Madras Harbour Works, where it is now building the north pier, a younger brother giant being engaged on the south one.

The breakwater, which was completed in 1873, has so far well justified Mr. Walker's design of its length and direction, as well as by its stability that of Mr. Parkes for its structure.

It suffered some damage during the first few monsoons, but nothing very serious, and it now seems thoroughly consolidated, since the last four monsoons have done it no damage. The superstructure has settled down considerably into the rubble base, as much as 3 to 4 feet in the outer half length, and an additional top layer of concrete is being gradually carried forward as a convenience for access, though not as yet required for breaking the sea.

The cost of the breakwater (including percentage for engineering and office establishments, also share of plant, &c.) was nearly £109,000, being £1,000 less than Mr. Walker's estimate.

It should, however, be remarked that the breakwater work coming last, derived much advantage from the organisation and training of workmen on the earlier works.

The successful completion of the breakwater and services of the Engineers and staff employed on it, were favourably noticed by Her Majesty's Secretary of State for India, the Governments of India and Bombay, and the Commissioner in Sind.

Another smaller, but interesting, work, which did not form part of Mr. Walker's project, is the new light on Manora Point, the inauguration of which, on the 15th August 1877, was Sir William Merewether's last public act in reference to the harbour works, just before his leaving Sind for the Indian Council. This light will be further referred to in the enumeration of results.

The results, so far obtained, may be summarised as follows.

The scour by the groyne, aided indirectly by dredging and excavation at "deep water point," and largely by direct dredging on the "bar," has formed a direct entrance channel 500 feet in width, 20 feet deep at low water, and half a mile in length, which is sheltered by the Manora breakwater, and through which—according to the official directions for the port—vessels with a draught not exceeding 22 feet can now pass without difficulty during the S.-W. monsoon, and during the fair season, up to 24 feet draught, that is, two feet more than H. M.'s Indian troopships.

This is an increase of 5 to 7 feet during the monsoon, and 4½ to 6 feet during the fair season, as compared with the old directions.

It may be added that the draughts thus allowed are really limited more by the capabilities of the anchorage, than by those of the entrance, which could pass vessels of much heavier draughts at high water.

Practically, since the capacities for tonnage of different channels vary as the cubes of their depths, and allowing for its greater directness and shelter, the capabilities of the entrance may be fairly said to have been trebled.

The formerly frequent and long detention of vessels off the port, and sending them away to Bombay to lighten, are now unknown; the mail steamers are timed regularly, irrespective of tide, and the steam-tug is seldom required by sailing ships. The shelter of the breakwater also now enables native craft to enter and leave the port during their former close season, the S.-W. monsoon.

The anchorage has, speaking generally, been deepened, enlarged, and stilled, though much of what was gained at Keamari up to 1869 has been temporarily lost, through the material scoured out from the channel above by the Chinna creek diversion.

As it is, the most marked gain is in the low water area, which has increased from 778 to 868 acres; yet, the perfectly good deep water anchorage area has increased from 60 to 80 acres, and is capable of accommodating 20 vessels of 500 to 2,000 tons register, and even, with special mooring arrangements, so long a vessel as one of H. M.'s Indian troop ships, which commenced to work with this port in connection from the opening of the Indus Valley Railway system.

For the native sea-going and general lighterage trade in the upper harbour, a channel has been formed 1½ mile long, 500 to 300 feet wide, and averaging 5½ feet in depth at low water, giving access at most times of tide to the "Native Jetty," a work presenting 1,736 feet of wharfage, adapted to a depth of 10 feet, and 1,070 feet dry at low water, and comprising an area of five acres.

Over this jetty has hitherto passed the great bulk of the trade of the port, the exception being chiefly railway material and Government stores, which are landed at Keamari, where, however, the Indus Valley State Railway system called for more provision for through-traffic, of troops and stores, as well as produce.

Eastward of the jetty the channel, 1 mile in length, 290 feet wide, and 3½ feet deep at low water, at present only fulfils the one important object of tapping the east backwater, and so directing the scour into the channel below, but it also offers good facilities for the extension of wharfage along it, where needed.

In effecting the above improvements, the enormous quantity of more than 3½ millions of tons of material (chiefly sand) has been removed from the entrance and lower harbour, of which one-fourth was effected by dredging and three-fourths by scour, and from the upper harbour channel more than 2½ million tons, one-third of which was effected by dredging and excavation, and the rest by scour. Adding the two, gives over 6½ millions of tons of material removed, or enough to cover 488 acres one fathom deep.

This quantity, large as it is, did not more than half exhaust the capability of the scour works, for enlargement of the harbour; they still required several

years, and considerable aid by dredging, with some further auxiliary works of no great cost, to develop their full effects.

The cost of the works described was £490,940. The amount might have been considerably less, and the results greater, had the works been carried on in a different order, and without stoppage or delays in execution by short supply of funds.

(To be continued.)

PRINCIPLES OF MECHANICS.

BY A. EWANK.

VI.

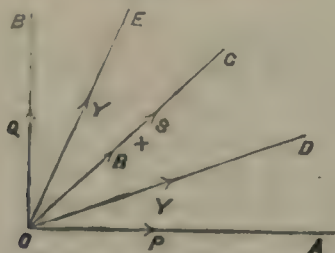
THE method illustrated in the last example, where a rod or bar was resting with one end on a horizontal floor, leads us to the following general theorem. Let P, Q, R be three forces which act on a body and which preserve equilibrium. Let the lines of action of any two forces meet in a point O. Then the line of action of the third must pass through O.

For instance, let the student draw at random any three straight lines on the desk or table at which he may be sitting. These lines will probably form a triangle of finite area. If they do so, it will be impossible to find three forces—each different from zero, or two of them different from zero—which act along these lines and keep equilibrium. If he so constructs the lines that they pass all through some one point, then it will be possible to find three suitable forces. If one force along one line is chosen at random, there is only one value possible for the force along either of the other lines.

For example, if he chooses 6lbs. for the force along one line, and if forces of 5lbs. and 9lbs. will be suitable for the other lines, then the numbers 5 and 9 are the only suitable ones. All these statements the reader should now be able to prove for himself.

We will now consider some resultants where the component forces act at angles other than 90° or at 45° . If the reader will carefully reflect on the method by which we obtained the resultant of equal forces at 90° or at 45° , he will see that it can be generalised as follows. If he thinks it necessary he should draw for himself a diagram similar to that of *fig. 11*.

Fig. 11.



Let forces of 1lb. and 1lb. act at an angle at present undetermined. Let their resultant be known to be x lbs. Here then x is a known number which cannot exceed 2 and must be less than 2, unless the angle is zero. Along the line of the resultant add 2lbs. Then re-arrange the forces. Let the first two forces be called P and Q and the added forces be called R and S, as in *fig. 11*. Take P and R to give an unknown resultant y . Take Q and S to give the same unknown resultant y . These two y forces act at an angle equal to that between P and R. Therefore their resultant is y times y or y^2 . Therefore $y^2 = 2 + x$. By this method we obtain the resultant y of two forces at any angle, a if we know the resultant for the double angle $2a$. Thus knowing the resultant for 90° we successively deduce resultants for 45° , $22\frac{1}{2}^\circ$, $11\frac{1}{4}^\circ$ and so on. We are therefore able to assign resultants for a long series of angles. The series is really infinite, but we may be supposed to stop when we reach an angle so small that our ordinary sextants or theodolites would not be able to measure it.

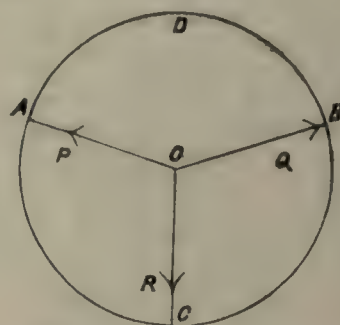
If we desire the resultant of 1lb. and 1lb. at $22\frac{1}{2}^\circ$ we have $x = 1.84$ approximately and then $y^2 = 2 + 1.84 = 3.84$. Then $y = 1.96$ approximately. Then for $11\frac{1}{4}^\circ$ $y^2 =$

$2 + 1.96 = 3.96$ approximately and so on. The values once found might be registered in a table, and, if we were so registering them, we should commence by calculating $\sqrt{2}$ with a great exactness of approximation. Then the succeeding values would be closer in approximation than those which we have found.

But no such table of resultants has perhaps ever been made, because, as we shall by and by discover, there is already a registered table called a table of cosines or table of natural cosines, which practically gives us the quantities we need.

Our reasoning is, and will remain, purely mechanical. But if as a result of purely mechanical reasoning we arrive at certain numbers, and if as a result of purely geometrical or trigonometrical reasoning, the geometer arrives at the same numbers (with, however, different meanings) we can use his results when once we have convinced ourselves of the—accidental, so to say—identity of the two sets of numbers.

Fig. 23.



Another set of resultants can be found as follows. In *fig. 23*, A B C are three points in a circle such that arc AB = arc BC = arc CA. O is the centre and thus the angle AOB is 120° . At O let us imagine a small ring to which are tied the strings OA, OB, OC.

Along the strings act equal forces P, Q, R, say, each of 1lb. Then it is clear that the ring cannot move any way. But P and Q would tend to pull the ring towards D where OD bisects AOB, and this line OD is the prolongation of CO. Thus the force R must act along OC with the same intensity as does the resultant along OD of the forces P and Q. That is, this resultant must be 1lb. We therefore know that equal forces P, Q at 120° produce a resultant equal in magnitude to either.

We can now proceed to calculate what 1lb. and 1lb. would produce at an angle of half AOB, i.e., an angle of 60° . We have as before $y^2 = 2 + x$. Here x is 1 and $y^2 = 3$. Thus 1lb. and 1lb. at 60° produce exactly a resultant $\sqrt{3}$ lbs.

To realise this more clearly we must approximate. We find $\sqrt{3} > 1.7320$ and < 1.7321 . Thus forces of 10lbs. and 10lbs. at 60° produce 17.32lbs. nearly; or forces of, 100lbs. and 100lbs. produce 173lbs. nearly. The error in the last statement is less than .21lbs. and therefore less than $\frac{1}{4}$ lb.

The student is now able to show that 12lbs. and 12lbs., at an angle 90° produce a less effect than 10lbs. and 10lbs. at an angle of 60° .

Just as we derived the resultant at 60° from that at 120° we may derive the resultant at 30° from knowing that at 60° . If y be the resultant of 1 and 1 at 30° $y^2 = 2 + \sqrt{3} = 3.7320$ nearly and y may be thence calculated. Thus we now know how to find resultants for equal forces at any of the angles comprised in the series 60° , 30° , 15° , $7\frac{1}{2}^\circ$, $3\frac{3}{4}^\circ$ and so on.

All these results would be successively calculated and they could, if wished, be embodied once for all in a table.

The student may think it curious that we should thus be able to calculate resultants for angles 90° , 45° , $22\frac{1}{2}^\circ$, &c., and also for angles 60° , 30° , 15° , &c., and yet not apparently be able to calculate resultants for 80° , 40° , 20° or for 70° , 35° , $17\frac{1}{2}^\circ$. But in the sequel we may manage so to generalise our methods as to make them apply to all angles.

				Safe distributed load in lbs. per foot run on the following spans in feet.																									
Depth in inches.	Width of flange in inches.	Weight in lbs. per foot.	Area in sq. inches.	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26			
3	1 1/2	5	1.5	949	486	282	177	119	83	61	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	1 1/2	10	3.0	1898	972	564	354	238	166	122	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	1 1/2	4 1/2	1.35	927	474	275	173	116	81	60	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	1 1/2	5 1/2	1.5	1030	527	305	192	129	90	66	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	1 1/2	6 1/2	1.6	1130	580	335	212	141	100	73	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	2 1/2	6 3/4	2.2	...	1130	654	412	276	194	141	106	84	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	2 1/2	7 1/4	2.2	...	...	702	442	296	208	152	114	90	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	2 1/2	7 3/4	2.7	...	...	872	549	368	258	188	141	112	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	2 1/2	7	2.1	...	...	700	441	295	207	151	114	90	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	2 1/2	8	2.4	...	...	800	504	338	237	173	130	103	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	3	11	3.3	...	...	1100	693	465	325	238	179	141	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	3	12	3.6	...	...	1200	756	507	355	260	195	154	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	3	12	3.6	...	...	...	956	641	450	328	247	190	150	120	...	...	...	...	...	...	...	...	...	...	...	...
4	3	13	3.9	...	...	...	1100	733	515	375	282	217	171	137	...	...	...	...	...	...	...	...	...	...	...	...
4	3	13	3.9	...	...	...	689	462	324	236	178	137	108	86	...	...	...	...	...	...	...	...	...	...	...	...
4	3	13	3.9	...	...	...	799	535	376	274	206	159	125	100	...	...	...	...	...	...	...	...	...	...	...	...
4	3	13	3.9	...	...	...	907	606	426	311	233	180	141	113	...	...	...	...	...	...	...	...	...	...	...	...
4	3	13	3.9	...	...	...	712	477	334	244	183	141	111	89	...	...	...	...	...	...	...	...	...	...	...	...
4	3	13	3.9	...	...	...	889	596	418	305	229	176	138	111	...	...	...	...	...	...	...	...	...	...	...	...
4	3	13	3.9	...	...	...	1156	775	534	396	299	229	179	144	...	...	...	...	...	...	...	...	...	...	...	...
4	3	13	3.9	...	...	...	1267	849	596	434	326	251	198	158	...	...	...	...	...	...	...	...	...	...	...	...
4	3	13	3.9	...	...	...	1110	748	526	383	285	222	174	139	...	...	...	...	...	...	...	...	...	...	...	...
5	2 1/2	11 1/2	3.5	...	...	...	...	758	533	388	289	224	177	141	...	...	...	...	...	...	...	...	...	...	...	...
5	3	13	3.9	...	...	...	...	857	602	439	329	254	199	159	130	...	...	...	...	...	...	...	...	...	...	...
5	3	13	3.9	...	...	...	...	972	683	498	374	288	226	181	147	...	...	...	...	...	...	...	...	...	...	...
5	3	13	3.9	...	...	...	...	1370	961	700	527	405	319	255	207	...	...	...	...	...	...	...	...	...	...	...
5	3	13	3.9	...	...	...	...	1450	1019	743	557	430	337	269	220	...	...	...	...	...	...	...	...	...	...	...
5	3	13	3.9	...	...	...	...	1630	1150	836	628	484	380	304	247	...	...	...	...	...	...	...	...	...	...	...
5	3	13	3.9	...	...	...	...	797	559	408	306	236	185	148	121	99	83	70	...	...	...	...	...	...	...	...
5	3	13	3.9	...	...	...	...	817	574	418	314	242	190	153	124	102	85	71	...	...	...	...	...	...	...	...
5	3	13	3.9	...	...	...	...	936	653	479	360	277	218	175	142	117	98	82	...	...	...	...	...	...	...	...
5	3	13	3.9	...	...	...	...	918	640	469	353	272	214	171	139	114	96	81	...	...	...	...	...	...	...	...
5	3	13	3.9	...	...	...	...	1140	793	582	437	337	265	212	172	142	119	100	...	...	...	...	...	...	...	...
5	3	13	3.9	...	...	...	...	1340	932	685	515	396	311	249	202	167	139	117	...	...	...	...	...	...	...	...
5	3	13	3.9	...	...	...	...	1160	809	594	446	344	271	216	176	145	121	100	...	...	...	...	...	...	...	...
5	3	13	3.9	...	...	...	...	1520	1060	780	586	449	355	284	231	190	159	130	...	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	993	730	548	420	318	265	215	178	148	122	...	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	1250	920	624	476	351	298	250	200	168	140	...	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	1790	1310	986	756	571	478	390	320	268	220	...	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	1857	1359	1022	784	593	496	404	332	278	228	...	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	1920	1410	1060	811	613	513	417	344	287	236	...	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	1987	1459	1096	839	635	531	431	356	297	244	...	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	2050	1500	1130	868	655	549	448	368	306	252	...	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	...	792	580	436	334	262	211	173	142	118	97	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	934	686	515	395	312	250	204	167	139	115	...	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	...	844	634	488	384	307	250	206	171	145	...	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	...	950	714	548	432	345	282	232	193	163	...	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	...	510	383	295	232	186	151	125	104	88	74	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	...	578	434	335	263	212	171	141	118	99	84	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	...	672	505	389	306	245	199	164	137	115	98	...	...	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	...	765	575	443	349	279	226	187	156	131	111	96	83	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	...	833	627	482	379	304	247	203	173	143	122	104	90	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	...	1007	737	567	446	357	290	239	200	168	143	123	106	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	...	1120	818	629	495	397	322	266	221	186	158	134	117	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	...	892	670	516	406	326	265	218	181	153	130	112	96	...	...	...	...	...
6	3	15	4.5	...	...	...	...	...	...	1105	837	645	507	407	331	272	226	191	162	140	120	103	91	...	...	...
6	3	15	4.5	...	...	...	...	...	...	926	696	536	421	337	274	226	188	159	135	116	100	87	77	...	...	...
6	3	15	4.5	...	...	...	...	...	...	1235	946	728	572	458	373	307	253	215	183	157	136	119	104	...	...	...
6	3	15	4.5	...	...	...	...	...	...	1300	994	766	602	482	392	323	269	226	193	165	143	125	109	...	...	...
6	3	15	4.5	...	...	...	...	...	...	1920	1440	1110	873	709	569	468	390	329	280	240	207	181	158	...	...	...
7	2 1/2	14	4.2	...	...	...	...	...	...	1075	808	623	490	392	319	265	217	184	157	134	116	102	89	78	...	...	
7	2 1/2	14	4.2	...	...	...	...	...	...	941	707	546	428	343	279	230	191	161	137	118	102	89	78	...	...	...
7	2 1/2	14	4.2	...	...	...	...	...	...	806	606	466	367	293	239	197	164	138	117	101	87	77	66	...	...	...
7	2 1/2	14	4.2	...	...	...	...	...	...	1144	859	662	520	417	339	279	233	196	167	143	124	107	88	...	...	...
7	2 1/2	14	4.2	...	...	...	...	...	...	1190	897	691	543	435	354	291	243	205	174	149	129	112	98	...	...	...
7	2 1/2	14	4.2	...	...	...	...	...	...	1530	1150	885	696	558	453	374	311	262	223	191	165	144	126	...	...	...
7	2 1/2	14	4.2	...	...	...	...	...	...	1610	1210	934	734	588	478	394	328	276	235	202	174	152	133	...	...	...
7	2 1/2	14	4.2	...	...	...	...	...	...	958	720	552	436	349	284	234	195	164	139	120	103	90	79	...	...	...
7	2 1/2	14	4.2	...	...	...	...	...	...	1230	92															

Safe distributed load in lbs. per foot run on the following spans in feet.

				Safe distributed load in lbs. per foot run on the following spans in feet.																																					
Depth in inches.	Width of flange inches.	Weight in lbs. per foot.	Area in sq. inches.	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39											
22	4	29	8.1	1161	962	780	648	537	452	385	327	285	247	215	191	168	...	...	...	...	...	...	...	...	...	...	...	...	...	...
22	4	17	5.1	792	623	506	417	348	293	249	218	192	161	141	124	109	...	...	...	...	...	...	...	...	...	...	...	...	...	...
22	4	38	11.5	1863	1492	1228	999	833	702	597	572	442	388	337	296	262	...	...	...	...	...	...	...	...	...	...	...	...	...	...
22	4	30	9	...	1190	972	801	668	563	478	410	354	309	270	237	210	187	165	...	...	...	...	...	...	...	...	...	...	...	...
22	4	26	7.6	...	1030	840	695	580	480	425	307	354	268	235	207	183	162	143	...	...	...	...	...	...	...	...	...	...	...	...
22	4	22	6.7	...	999	812	669	558	470	400	342	294	255	225	198	175	156	139	125	...	...	...	...	...	...	...	...	...	...	...
22	4	20	6.2	...	873	710	585	488	411	347	290	258	225	197	173	153	136	122	109	...	...	...	...	...	...	...	...	...	...	...
22	4	20	6	...	841	685	564	472	396	335	288	248	216	191	167	147	131	117	105	...	...	...	...	...	...	...	...	...	...	...
22	4	24	7.2	...	1010	821	677	564	475	404	340	299	267	228	201	177	158	141	127	...	...	...	...	...	...	...	...	...	...	...
22	4	24	6.1	...	864	702	579	483	406	345	296	256	223	195	171	152	134	120	108	...	...	...	...	...	...	...	...	...	...	...
22	4	24	7.5	...	1070	867	715	596	502	427	366	317	276	241	211	187	167	149	133	...	...	...	...	...	...	...	...	...	...	...
22	4	27	8.1	...	1150	936	772	643	542	461	395	341	297	260	229	202	179	160	144	...	...	...	...	...	...	...	...	...	...	...
22	4	27	8.5	...	1200	980	807	672	567	482	413	357	311	272	239	212	188	168	150	...	...	...	...	...	...	...	...	...	...	...
22	4	37	11.1	...	1570	1280	1060	880	742	630	540	467	407	356	313	277	246	219	197	...	...	...	...	...	...	...	...	...	...	...
22	4	29	8.7	...	1290	1040	862	719	606	515	440	381	332	291	255	226	201	179	161	...	...	...	...	...	...	...	...	...	...	...
22	4	30	9.3	...	...	1076	892	744	627	543	456	395	345	301	264	234	208	185	167	...	...	...	...	...	...	...	...	...	...	...
22	4	30	9.1	...	...	1180	972	810	683	580	498	430	375	328	288	255	226	202	181	163	147	...	...	...	...	...	...	...	...	...		
22	4	36	11.8	...	...	1410	1160	964	812	691	592	511	446	390	342	303	269	241	216	194	176	...	...	...	...	...	...	...	...	...		
22	4	39	11.7	...	...	1520	1250	1040	880	749	642	554	483	423	371	329	292	261	234	216	190	...	...	...	...	...	...	...	...	...		
22	4	39	8.5	...	...	1130	930	776	654	556	477	412	359	314	276	244	217	194	173	156	141	...	...	...	...	...	...	...	...	...		
22	4	30	9	...	...	1200	980	825	694	591	506	437	381	334	293	259	230	206	184	166	150	...	...	...	...	...	...	...	...	...		
22	4	31	9.3	...	...	1240	1029	852	717	610	523	452	394	345	303	267	238	212	190	171	155	...	...	...	...	...	...	...	...	...		
22	4	32	9.6	...	...	1280	1050	880	741	630	540	466	407	356	312	276	246	219	197	177	160	...	...	...	...	...	...	...	...	...		
22	4	37	11.1	...	...	1480	1220	1020	857	728	624	539	470	412	361	320	284	254	228	205	185	...	...	...	...	...	...	...	...	...		
22	5	33	10	...	...	1340	1100	921	776	660	565	480	426	373	327	290	257	230	206	186	168	...	...	...	...	...	...	...	...	...		
22	5	36	10.8	...	...	1440	1190	989	833	709	607	525	457	400	352	311	276	247	221	199	180	...	...	...	...	...	...	...	...	...		
22	5	42	12.7	...	...	1690	1390	1160	978	832	713	616	537	470	413	365	325	290	260	234	211	...	...	...	...	...	...	...	...	...		
22	6	36	16.8	...	...	2240	1850	1540	1330	1100	945	816	712	623	547	484	430	385	345	310	280	...	...	...	...	...	...	...	...	...		
22	6	43	12.9	...	...	1720	1420	1150	995	846	725	627	546	478	420	371	330	295	265	238	215	...	...	...	...	...	...	...	...	...		
22	6	50	15	...	...	2000	1650	1370	1160	984	846	729	636	556	488	432	384	343	307	277	250	...	...	...	...	...	...	...	...	...		
22	6	54	16.2	...	...	2160	1782	1482	1252	1064	912	789	688	600	528	468	416	371	331	297	270	...	...	...	...	...	...	...	...	...		
22	6	51	15.3	...	...	2040	1680	1400	1180	1010	861	743	648	567	498	441	392	350	314	282	255	...	...	...	...	...	...	...	...	...		
22	6	34	11.2	...	...	...	1190	986	850	714	612	544	476	425	374	320	272	238	210	190	170	...	...	...	...	...	...	...	...	...		
22	6	37	11.5	...	...	...	...	1270	1070	918	781	675	588	515	452	400	355	317	285	255	233	210	191	174	...	...	...	...	...	...					
22	5	36	10.8	...	...	...	...	1200	1005	860	735	640	555	485	430	380	355	300	267	242	221	200	180	164	...	...	...	...	...	...					
22	5	47	14.1	...	...	...	...	1560	1310	1120	969	829	724	633	555	491	437	390	349	315	284	258	234	214	...	...	...	...	...	...					
22	4	40	12.2	...	...	...	...	1300	1100	948	819	714	624	548	485	431	385	345	311	281	254	231	211	193	177	...	...	...	...	...						
22	5	43	12.9	...	...	...	...	1390	1180	1010	874	762	667	586	518	461	412	369	332	299	272	247	225	206	189	...	...	...	...	...						
22	5	46	13.8	...	...	...	...	1480	1270	1083	936	815	714	627	554	493	440	395	355	321	290	265	241	220	202	...	...	...	...	...						
22	5	50	16.9	...	...	...	...	1830	1580	1330	1160	1000	877	770	684	605	540	485	436	394	357	325	296	271	248	...	...	...	...	...						
22	5	52	12.6	1400	1190	1020	883	768	672	591	523	465	415	372	335	302	274	249	227	208	190	176										
22	5	54	16.2	1800	1530	1310	1130	988	865	759	672	597	533	478	430	389	352	320	292	267	245	225										
22	6	47	14.1	1570	1330	1140	987	860	753	661	584	520	464	416	375	338	307	279	254	232	213	196										
22	6	56	16.4	1860	1580	1360	1180	1030	897	788	697	619	553	496	446	403	365	332	303	277	254	233										
22	6	57	17.2	1910	1630	1400	1207	1050	921	810	715	636	568	509	458	414	375	341	311	284	261	239										
22	6	60	18.2	2020	1720	1480	1270	1110	973	854	756	672	600	538	484	437	397	360	329	300	276	255										
22	6	58	17.6	1950	1660	1420	1230	1070	937	823	727	647	578	518	466	421	381	347	316	289	265	243										
22	6	66	19.8	2200	1880	1600	1380	1210	1060	928	821	730	652	584	526	475	431	397	357	326	299	275										
22	7	75	22.5	2500	2120	1820	1580	1370	1200	1050	933	829	741	661	598	540	489	445	406	371	340	312										
22	5	53	15.9	1620	1390	1207	1052	921	809	715	636	568	509	459	414	375	341	311	284	261	239	221									
22	6	60	18.1	1860	1590	1380	1200	1050	923	817	726	648	581	523	473	427	390	355	325	298	273	252									
22	6	64	19.2	1970	1690	1460	1270	1110	974	864	768	683	615	554	500	453	412	376	343	315	289	267									
22	6	67	20.1	2060	1770	1530	1330	1160	1020	904	804	718	644	579	523	474	431	393	359	330	303	279									
22	6	64	19.2	1380	1184	1020	891	781	685	606	539	481	431	389	353	318	289	263	241	221	203	187									
22	6	64	16.2	...	...	...	...	...	1710	1460	1260	1100	964	847	749	666	595	533	480</																	

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

XXI.

Cement plaster $\frac{1}{2}$ " thick.

Items per 100 s. ft.	No. or quantity.	Rate.	Amount.	Total.
(1)	(2)	(3)	(4)	(5)
<i>Labor.</i> —				
Plasterer No. ...	1 $\frac{1}{2}$	Variable.	Do.	Do.
Coolie " ...	2			
Do. " ...	4			
Bhistie " ...	1			
Sundries " ...	...		
<i>Materials.</i> —				
Portland Cement lbs...	280	Variable.	Do.	Do.
Sand c. ft. ...	6 $\frac{1}{2}$			
Sundries & Scaffolding	.....		
Petty Establishment	.....		

Note.—For cement plaster $\frac{1}{4}$ " thick, half the above materials are required; and of labor, 1 $\frac{1}{4}$ plasterer, $\frac{1}{4}$ coolie, and $\frac{1}{4}$ bhistie.

CHINA.

(From our own Correspondent.)

THE subject of Railways is now attracting more than passing interest in this country, and the plan of the Nilgiri "Rigi" Railway, together with Mr. A. Pierre de Closett's letter bearing on that particular line, which appeared in your issue of the 8th October, are just the kind of things we wish to see.

The doings of the Russians in Siberia, and elsewhere in Russian Territory, as reported quite recently in our local native and foreign papers, have excited a sort of dread in the majority of Chinese Government officials, lest the Russians should advance at Railway speed to the invasion and annexation of their little Tributary Kingdom, Corea.

The line which is to connect the Russian port of Vladivostok on the Pacific, to the Caspian Sea is to be on the Lartigue Elevated Single Rail System, with five ton, three-wheeled locomotives that will go around curves of forty-six feet radius. Heavier engines, weighing twelve tons each, will also be used, if the traffic warrants such a step to be taken. Platform waggons, each fitted to carry two twelve-pounder field-guns ready mounted on their own carriages, and carrying a quantity of suitable ammunition beneath the platforms, are also being furnished. Waggons, each to carry four horses, are also being supplied. These latter are so fitted that the sides of the waggons when let down serve as platforms, over which the horses walk with perfect safety into the carriages, and without trouble. A complete battery of Field Artillery, with its eight guns, a good stock of ammunition, and its full complement of men and horses are to make up a single train. The same train may be stopped anywhere along the line,—the guns, horses, and men, being all present, with every requisite to enable them to commence action at once. The Westinghouse brake being fitted to every carriage, and the whole train coupled by Stone's patent coupling, moves off without any jarring or jerking and is stopped easily and quickly wherever necessary. The Russians are no doubt practical people, in Railway matters at least, and their selection of the Lartigue system as the best suited to their requirements over hills, and across deserts, says a good deal for this hitherto little known system of Elevated Railway. A proposition has been made to connect a Copper Mine in the Yang-tze Valley with the nearest port on the same river, by a line of Railway on the Lartigue System.

The line will be a little over one hundred miles long, and will be equal to transporting about 500 tons of mineral to the waterside, besides a considerable number of passengers, and some merchandise. Your correspondent was asked to accompany certain native officials to Yun-nan, with a view of ascertaining if it was possible to connect certain mines in that distant province with some suitable

market for their produce, by a Railway on the Lartigue Elevated Single Rail System. It is generally understood that a meeting is to be held sometime next week with a view of discussing the matter thoroughly. Plans of the line and rolling-stock used by the Russians are to be produced.

The Railway now being built in the Province of Chih-li to connect the Kai-ping Coal Mines with the Taku Docks, and the Treaty Port of Tientsin is getting on passably well, I hear, although the Company has been put to great expense on account of the recent floods which have washed away a considerable portion of the embankments raised ready to receive the rails. The Province of Chih-li being subject to periodical inundations the Company is likely to have a great deal of trouble on account of the water, and the Directors have been blamed for not having adopted the Lartigue Elevated System instead of a ground line. The Lartigue Rail being elevated 3, 5, or more feet above the ground allows the water to flow freely between the trestles, and that without interruption of the traffic. The company is, however, fortunate in having a great abundance of cheap, if not experienced, labourers at hand, so that the damage done by the water may be easily repaired. An experienced Engineer tells me that when the Chinese have had a little more practice they will be able to build Railways more rapidly and more economically than any other country in the world. From the results of my own experience, I am disposed to believe my friend right in this respect. It would be a mistake however to expect a single Chinaman to compete successfully, in hard work like cutting and excavating, against an English navvy, but the unlimited number of Chinese available for such work makes up for the difference, and really gives Railway men in this country most promising hopes for the future.

The two Railways now being constructed in the Island of Formosa are, I am assured, making but slow progress, however, a fact which must be explained by the relaxing effects of the climate on the muscle of the Northern men employed there.

The men employed are soldiers recruited in the Province of An-Hui, principally to the North of the Yang-tze River, where the climate is dry, cold and bracing, whereas it is the very opposite in Formosa. Then the men say we were engaged as soldiers and not as coolies, and many refuse to work as well as they might do were it otherwise.

Cantonese, who have worked on the Railways in California and other parts of the United States, might of course be had, but the Governor of Formosa is not disposed to pay such men the wages they would ask if employed, hence the difficulty.

At present a small Railway is very much needed for the coal mines of Kai-Kien-Hsien, in the Northern part of Kuang-Tung Province whence coal is taken down to Feng-Chuan-Hsien on the West River just below the frontier limit of Wu-Chou-Fu in Kuang-Si Province. The coal has to be transhipped three times before reaching Canton, and is delivered in a wet, mucky state, owing to the smallness of the boats employed to shoot the rapids at the very commencement of the transit journey. A line of Railway, thirty or forty miles long on the Single Rail Elevated System, could easily be constructed to bring down the coal to a place ready for shipment, at very small cost. Strange to say, the Cantonese who so readily emigrate to foreign countries are opposed to any such innovations, as Railways of any kind in their own country, and nearly destroyed a river steamer a few weeks ago for having exhibited the electric light on board.

I am sorry to have to record a fearful calamity that has overtaken the residents in Ho-Nan Province, specially those living in the neighbourhood of the Yellow river. It appears that early in the month of October, the southern embankment of the river gave way under unusual pressure, near the city of Chêng-Chou, in the Prefecture of Kai Feng-Fu, Ho-Nan Province.

The rush of water is said to have overthrown and carried everything before it. Over two millions of people are said to have been drowned, and millions more deprived of all they possessed in the world. The Empress Dowager has sent Tls. 100,000 from the Privy Purse, and directed that Tls. 500,000 more be sent for the immediate relief of the suffering survivors of this fearful flood. Two foreign Engineers have been sent to see what can be done, and two millions of taels decreed for the work necessary to confine the river within reasonable bounds.

BOMBAY.

(From our own Correspondent.)

It is intended within the next few days to remove the wall standing in the channel, or passage between the Princes Dock, and the New Dock, just completed, this wall being about 70 feet long, 29 feet deep, and 17 feet thick at the base. It is now being pared down to a uniform thickness of about 7 feet, and will ultimately be blasted out by means of Dynamite.

A series of boreholes in rows, spaced horizontally, about 8 feet apart, and again 6 feet apart from row to row will be made; each borehole receiving a charge of about 7 lbs. of Dynamite connected with an Electric fuse. Each row of 8 holes will be discharged separately, the 8 holes being fired simultaneously by electricity; and so on row after row until the wall is completely removed, which process will probably occupy two days. The authorities are timid about having the whole series of shots fired simultaneously, though such a blast would remove the wall at once.

An effort is being made by a local firm, Messrs. Ewart Latham and Co., Agents of the International Water and Sewage Purification Co., London, to introduce into India the Magnetic system of purification of sewage, which has proved so conspicuous a success at home, notably in connection with the Acton Main Drainage Works. The system in question is known as the Magnetic Carbon system, and some idea of the relatively small space in which the Carbon can operate may be gathered, when I mention that the filter bed at Acton, where provision is made for the requirements of a population of 20,000, occupies an area of less than 70 feet square. This Carbon mixed with sand, or small gravel, forms a practically everlasting filter bed, equally well adapted for water or for sewage effluents. It has been carefully examined by Dr. Angell, F. R. C., who reports the following experiments, demonstrating the potency of the material as an oxydiser:—

"Experiment No. 1.—Ordinary domestic sewage was passed through 9 inches of Magnetic Spongy Carbon. By the permanganate test, it was found that 94 per cent of the oxydizable organic matter was destroyed or rendered innocuous.

"Experiment No. 2.—To demonstrate the destruction by oxidation of foul gases in solution. Taken a solution of sulphuretted hydrogen, equivalent to 4.2 grains of oxygen per gallon. After filtration by permanganate test not a trace of sulphuretted hydrogen was left.

"Experiment No. 3.—I find that the Magnetic Spongy Carbon, notwithstanding that it permits the free transit of air and gases, is quite impermeable to atmospheric germs. An organic solution containing gelatine, cabbage water, turnip juice and urine, was found to keep unchanged, the air being perfectly sterilized by its passage through the granules of Magnetic Spongy Carbon.

"These and other tests to which I have subjected the material, satisfy me that it is a very valuable substance for the filtration of water, sewage effluents, air and gases."

The cost of this Carbon is comparatively small, being only £6 per ton, and Indian Municipalities might do well to adopt the Magnetic System of purification under reference in view of its cheapness and efficacy.

The Health Officer of this City has just issued his report for the second quarter of 1887. During the period under review 4,933 deaths occurred, being 86 less than in the last quarter, and 343 less than in the corresponding quarter of the preceding year. The death rate is equal to 25.52 per thousand of population calculated on the census of 1881, and 22.37 by allowing for the increase of population since 1881. 2,933 persons, including stillborn, were born in Bombay in the quarter; and of the 4,933 deaths, 1,378 were due to fever. The rate of mortality of the chief races living in the City is shown below:—

	Per thousand of population.
Hindoo	49.69
Mussulmans	39.95
Parsis	20.90
Europeans	19.51

In this report the Health Officer lays stress on the fact that there is no accommodation at Railway stations for sick persons. He states that the conditions under which 3rd class passengers are carried to, and unloaded in this City, must have an injurious effect on the health of the passengers generally, and also on the health of the City. The absence of proper latrine accommodation in 3rd class carriages inflicts very great suffer-

ing on passengers. From the foregoing statistics, there would appear to be an unaccountable disparity between births and deaths in favor of the latter, which the Health Officer's Report makes no attempt to explain.

Tenders were recently invited by the Bombay Corporation for laying water Mains in Arthur Road, and the Acting Municipal Commissioner recommended the acceptance of the second lowest which amounted to Rs. 26,325, the lowest being Rs. 22,926; but the Town Council refused to adopt this recommendation, considering that the lowest tender ought to be accepted. The Acting Commissioner in a letter addressed to the Secretary of the Town Council placed on record his reason for recommending the second lowest tender for acceptance. The parties who submitted the lowest tender, he said, had other tenders on their hand and he was of opinion that they could not carry out their contract, except at a considerable loss to themselves. He considered it unwise to entrust work to contractors who must either lose if they do their work well, or save themselves from loss by doing bad work. This was a reasonable view to take of the case, but, nevertheless, the Town Council, in its wisdom, thought otherwise and the Acting Commissioner had to consent under protest to the acceptance of the lowest tender.

The weather here has been of a most unusual character lately. Until yesterday, it rained almost continuously since the 31st ultimo, causing the streets to be in a very filthy condition. I pity the poor people who were in tents all the time.

BOMBAY; July 7, 1887.

XENOPHON.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, December 31, 1887.

Upper Burma.

With reference to *Burma Gazette* Notification, dated the 3rd December 1887, Mr. W. W. Robertson, Honorary Assistant Engineer, reported his return from leave on medical certificate on the forenoon of the 20th instant and is transferred from the Minbu to the Shwebo division.

Madras, January 3, 1888.

The following appointments are made:—

Mr. J. W. Martin, Executive Engineer, 1st Grade, *sub-pro tem.*, to officiate as Superintending Engineer, IV Circle, during the absence of Colonel J. Beatty, R.E., or until further orders.

Mr. G. B. Lambert, Executive Engineer, 4th Grade, temporary rank, will hold charge of the Coimbatore Division during Mr. J. W. Martin's employment on other duty, or until further orders.

Hyderabad, January 3, 1888.

Rai Sahib Fakir Chand, Assistant Engineer, 2nd grade, is transferred from the Melghat Roads Sub-division to the East Berar Division.

Bombay, January 5, 1888.

With the approval of the Government of India, His Excellency the Governor in Council is pleased to make the following appointments:—

Colonel W. Merriman, R.E., on his return from leave, to be Superintending Engineer, West of India Coast Defences.

Lieutenant-Colonel E. D'O. Twemlow, R.E., to act in that appointment pending Colonel Merriman's return.

N. W. P. and Oudh, January 7, 1888.

Irrigation Branch.

With reference to Government of India, Public Works Department, Notification No. 404, dated 28th December, 1887, retransferring him to these Provinces, Mr. C. T. Evans, Executive Engineer, 2nd grade, is posted to the 2nd Circle, Irrigation Works.

Buildings and Roads Branch.

Rae Sohan Lal Saheb, Assistant Engineer, 1st grade, is transferred from the Meerut to the Agra Division, Provincial Works.

Central Provinces, January 7, 1888.

With reference to Government of India Notification dated 14th December 1887, Mr. P. W. Gilliland, Assistant Engineer, was relieved of his duties in the Hoshangabad Division, on the afternoon of the 20th December 1887.

India, January 7, 1888.

The undermentioned Apprentice Engineers, Punjab, are promoted to the rank of Assistant Engineer, 3rd grade, with effect from the dates specified against each:—

Mr. F. W. Schönemann,—4th November, 1887.

Mr. E. E. Taylor,—6th November, 1887.

Mr. J. A. Anderson, Executive Engineer, 1st grade, *sub-pro tem.*, State Railways, is, on return from furlough, transferred to Bengal, for employment on Railway Works.

Mr. W. T. Anstruther, Assistant Engineer, 1st grade, Punjab, on furlough, is permitted to resign his appointment in the Public Works Department, with effect from the 9th October, 1887.

Messrs. J. W. Parry, R. T. Denne, and A. Greenlees, Assistant Engineers, 1st grade, State Railways, are temporarily promoted to Executive Engineer, 4th grade, with effect from the 22nd November, 1st December, and 10th December, 1887, respectively.

The undermentioned Executive Engineers, 4th grade, temporary rank, attached to State Railways, reverted to their substantive rank of Assistant Engineer, 1st grade, with effect from the dates specified:—

Mr. G. Mills	...	13th October, 1887.
" H. B. Taylor	...	17th " "
" J. C. Mills	...	19th " "
" G. Denchairs	...	21st " "
" J. N. D. La Touche	...	29th " "
" R. C. Dyson	...	29th " "
" E. T. Faulkner	...	22nd November, 1887.
" W. R. Shaw	...	26th " "
" J. Manson	...	1st December, " "
" E. J. Alexander	...	7th " "
" J. F. H. Collet	...	10th " "
" C. E. O. Montresor	...	12th " "
" C. J. Cole	...	17th " "
" H. G. S. Savory	...	28th " "

Director-General of Railways.

Mr. A. C. C. Rogers, Executive Engineer, 3rd grade, is granted furlough for one year, with the usual subsidiary leave, with effect from such date as he may be permitted to avail himself of the same.

Mr. W. K. Stent, Executive Engineer, 2nd grade, is granted, furlough for eleven months, with the usual subsidiary leave, with effect from such date as he may be permitted to avail himself of the same.

Bengal, January 11, 1888.

Establishment—General.

Rai Anghore Nath Mookerjee, Sahib, Assistant Engineer, is transferred from the Dacca to the Chittagong Division.

Establishment—Railway.

With reference to Government of India, Public Works Department Notification dated 4th January 1888, Mr. J. A. Anderson, Executive Engineer, 1st grade, sub. *pro tem.*, is posted to the Eastern Bengal State Railway.

Establishment.

Mr. W. G. L. Cotton, Executive Engineer, Northern Drainage and Embankment Division, is appointed to officiate as Inspector of Local Works in the Rajshahye Division, during the absence of Mr. T. Beatty, on special leave, or until further orders.

Mr. R. E. Carter, Assistant Engineer, is appointed to hold temporary charge of the Northern Drainage and Embankment Division.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 5th January, 1888.

- 77 of '87.—William Robert Laing, of 10, Panmure Street, Dundee, in the County of Forfar, North Britain, Partner of the firm of Laing Brothers and Company, Stobwell Works, Dundee aforesaid, Jute Manufacturers.—For improvements in frames for spinning, doubling, twisting or roving jute, flax, hemp, cotton, worsted or other fibrous substances.
- 82 of '87.—Levi Hoffman Thomas, a citizen of the United States of America, and a resident of Chicago, in the County of Cook, and State of Illinois, U. S. A., Manufacturer.—For an improvement in paper bottles and machines for making such.
- 168 of '87.—Arthur George Meeze, of Redhill, in the County of Surrey (England), Consulting Engineer.—For improvements in the manufacture of illuminating gas and in apparatus therefor.
- 217 of '87.—William Barclay Wishart, Produce-dealer of Cawnpore, India.—For certain improvements to his patent General Utility Tent.
- 221 of '87.—Henry Sutton, of Ballarat, in the Colony of Victoria, Music Seller.—For an improved process of converting a photographic image on a gelatine surface into a relief or intaglio printing surface.
- 222 of '87.—John Gooch, of Brompton Road, County of Middlesex, England, Outfitter.—For improvements in shop fronts.
- 240 of '87.—John Clark, of 80, Great Brook Street, Birmingham, in the County of Warwick, England, Metallurgist.—For improvements in the process of obtaining alloys of aluminium with copper and with other metals.

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NOTIFICATION.

BANGALORE WATER-SUPPLY PROJECT.

Adverting to the last clause of Public Works Department Notification, dated 20th October 1887, published on the 12th, 19th, and 26th November 1887, the time allowed for submission of Essays to the Chief Engineer is extended from the 31st March 1888 to the 15th May 1888.

W. L. C. BADDELEY, CAPTAIN, R.E.,
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INDIAN ENGINEERING.

SATURDAY, JANUARY 21, 1888.

A NEW OVERLAND ROUTE.

JOHN BULL is a ruminating animal given to cautious chewing of reflection's cud before committing himself to action. But he is also wide awake in matters affecting his own interest, and when he sees which way that interest lies, is prepared to take advantage of any business opportunities vouchsafed him. Manchester, Birmingham, London, Glasgow, and other British trade centres are beginning to see splendid opportunities for trade in an exploitation of Upper Burma; and now that dacoitee is subsiding, and the country settling down to peace and quietude, British merchants are interesting themselves about trade routes to the new Eldorado, and seem inclined to back the courage of their hopes with the capital necessary for their realization.

Accordingly, we find a proposal before the public for an overland railway route from Calcutta to Bhamo and Mandalay.

The distance covered by such a line would be about 800 miles; the same distance let us say, as East Indian Railway trucks and carriages now run between Calcutta and Agra. Construction of what would practically be the first half of it, an extension from the Bengal Central Railway to Cachar to wit, has already been decided on. It remains to push with determination over the other half. General Dickens insists on the importance of the proposed line from a military point of view. We are content with a merely commercial point of view, and the consideration that it would tap India's eastern tea districts, and the undeveloped trade of the southern Chinese districts, and would rehabilitate Chittagong. Moreover, there are rich coal deposits in the Kubo Valley, and there is valuable timber in the Chindwin districts, besides mineral wealth.

Apropos of a Bengal-Burma Railway, "C. H. D." writes to the *Pioneer* suggesting that some 400 miles out of the seven or eight hundred required have either been made already, or have been determined on, and will shortly be made. He says the country to be traversed, and the existing and contemplated lines of railway, are as follows :—From Calcutta railway communication (5½ feet-gauge) already exists by the Bengal Central Railway to a place called Singhia (a little east of Jessore) for 83 miles. The Company have already proposed, for reasons unconnected with Burma to extend this line 80 miles further *via* Madaripur, to a point 8 miles west of Chandpur, the terminus of the proposed railway next to be mentioned at the confluence of the Dulasarai and Megna. From this latter point the Government of India have caused a complete survey to be made for a metre-gauge railway extending to Laksham, 32 miles to the east, and thence branching southward 89 miles to Chittagong, and north-eastward 192 miles to Cachar (thence extending also to Assam). This projected line is expected to be profitable, and the Government of India has considered it proper for the present to be kept in

reserve till a company may be formed to undertake it without a guarantee. Supposing these lines completed we should have then from Calcutta to Cachar :—

	Miles.
Calcutta to Ferry opposite Chandpur, $5\frac{1}{2}$ feet-gauge railway	163
Ferry	8
Chandpur to Cachar, via Laksham metre-gauge line	224
Total, Calcutta to Cachar ...	395

So far, so good. But now we leave *couleur de rose* behind, and are told of a mountainous tract of difficult country which the line would have to traverse for 75 miles to the edge of the Manipur valley. Beyond again is more hilly country; and the Chindwin and Irrawaddy rivers would have to be crossed before reaching Bhamo. "C. H. D." does not seem inclined to ignore difficulties. He admits that a railway line from Cachar to the Chindwin river, crossing that river to Polamoung must needs prove expensive in construction—200 lakhs of rupees is his estimate for this portion of the line—but nevertheless he believes that railway communication between Calcutta and Burmah may be opened at a total cost of about four millions sterling. This is of course very little better, or other than sheer guess work. It seems to us that this overland route to Burma stands more in need of surveys than it does of public countenance; that however much good will there may be towards it in English commercial circles, it cannot expect adequate support from them until proper surveys have been made, and some approximation to accurate information is available as to the country lying between Cachar and the Chindwin river, *vid* the Manipur valley. Since the English commercial world is just now in a humour to help and further railway enterprises tending to open out new markets for trade in Burma the sooner these surveys are made the better. They would be valuable in themselves, even if the railway line we have been considering should never get beyond the stage of projection.

"C. H. D." suggests that what he designates the Chandpur, Laksham, Chittagong, Cachar Railway, might meanwhile be set in hand. It has an independent value of its own, and need not wait for the other links. He would also have the extension of the Bengal Central Railway pushed on. Neither of these railways, he writes, "need cost much in the first season, as it will be desirable in such wet countries to carry out the earthwork first, and leave it to consolidate for a season before proceeding to lay the permanent way."

The *Pioneer* pertinently suggests in connection with this railway that a great point in its favor is that practically it would run within British territory throughout its entire length, and that it is a necessary corollary of the Assam-Chittagong system, the merits of which are generally admitted. For these reasons our Allahabad contemporary inclines to prefer a Bengal-Burma line of railway to the one advocated by Mr. Colquhoun; is indeed somewhat splenetic about Mr. Colquhoun, and the Moulemein-Siam line which he "has so pertinaciously forced upon the commercial public at home."

Did the *Pioneer* ever hear of the commercial public at home taking an interest in anything Indian, bar piece goods, and jute, and indigo, and so forth, *until* pertinaciously forced to yield attention to it? Mr. Colquhoun is, we think, to be commended for his perseverance. Experts must decide as to which of the schemes promises most for the public advantage. Meanwhile it is satisfactory to find that, whether by dint of Mr. Colquhoun's pertinaciousness, or "C. H. D.'s" modesty, or some other equally cogent factor, Lombard Street is interested in the commercial exploitation of Upper Burma. One of these fine days, peradventure, it may even be discovered that there is room and opportunity for both railways. Who knows! Burma is not like an equation value of x to be worked out on a slate. In any event there promises to be some very pretty engineering work to the fore.

SANITATION IN INDIA.

IF the individual who has succeeded in growing two blades of grass where one grew before, is a benefactor of the human race, much more so is he who has brought within the reach of the 'masses' the knowledge of how to protect their health. Air and water, two of the necessary conditions of our existence, are our greatest enemies if we do not keep them uncontaminated from poisonous surroundings. The very forces of nature which have been brought under subjection by man, to administer to his wants and comforts, are also his foes if not treated with care and forethought. Under these circumstances the question, "Is life worth living" becomes a problem of vital importance. One of the greatest triumphs of modern civilization is the victory which it has gained over evils attending a gregarious community. Hence it is that when the laws of the universe are thoroughly known, then the people enjoy the greatest immunity from the ills that flesh is heir to. Nature is a hard, stern, task-master, that will never permit of a violation of its laws with impunity. Of course climate is a potent factor that could not be eliminated from a consideration of the question, but climate alone would be of little avail if other circumstances did not come to its assistance. There are many parts of India in which the climate is as favourable as that of Europe, if not superior to it. But the conditions of existence are here so surrounded by opposing elements that it is not a matter of surprise India should prove to be the home of those terrible diseases which are rightly termed the scourge of humanity. The unclean habits of the lower orders of natives are pointed at as the prolific source of such diseases. This may be admitted, but do they explain everything? We make no allowance for the circumstances under which Indian towns have risen. Take for instance Calcutta itself, of which it is said with some degree of truth that while other cities attract the eyes of the traveller, the metropolis of British India appeals to him through his olfactory nerves. Are those who throw this accusation at our teeth aware how it has come to be in its present condition. Having been once covered by jungles, these had to be cut away before human habitations could be erected, and every available

space was taken advantage of to build a hut till further clearings could be made. Over-crowding was thus the natural consequence, and over-crowding brought in its train the concomitant evils, disease and death.—Granting this much, are we to sit with folded hands and permit death to carry on its work of wholesale destruction. If we are to wait till millions of money are expended upon the city to convert it into a smiling garden, one might as well postpone the event to the Greek Kalends. The terrible record of mortality in the Berars telegraphed the other day to a contemporary, tells its own tale of sadness and desolation. Everything that can be done to alleviate human suffering should be resorted to notwithstanding the conservative habits of the people. They must be shewn and taught the best preservatives of health. In this connection we would bring to the notice of the Government of India an admirable little *brochure* of 53 pages entitled "Simple Sanitary Rules for observance in villages and households during cholera epidemics," by Surgeon-Major Walter Garven King, M.B., C.M., of the Indian Medical Department. For anything to the contrary it might be accepted as a guide even in the absence of an epidemic, since it contains directions in regard to preventive measures, especially in out-of-the-way places, where the authorities have to contend with cholera by the help of untrained staffs. After giving a short account of the symptoms of the disease, and the agencies which tend to extend the area of its operations, he gives some useful practical hints to be adopted when a certain locality is threatened with a visitation, and gives wholesome advice in much the same spirit in which Cromwell addressed his following, "Trust in Providence, but keep your powder dry." Dr. King naively says :—"Every wise precaution having been taken by the aid of the senses which the Creator has given us, we should remain watchful as to the perfection of these arrangements and trust to His mercy. But to live in the midst of filth, which we know will enable the poison to grow and kill ourselves, our wives and children, and then say that the Great God has caused it, is to forget that He has furnished us, as He has not the lower animals, with sense enough to judge and act for ourselves." He says authoritatively that water is the principal medium by which cholera is disseminated, because the poisonous "particles cannot only live in water, but will actually increase to such an extent in it, that each drop may contain hundreds of poison-bearing atoms. If water is foul from entrance to it of common forms of dirt, such as is conveyed by the feet of persons when procuring water for drinking purposes, then the poison atoms will be under favourable conditions, they will increase enormously—literally, they are supplied thereby with good nourishment; whereas, if the water be pure, should the atoms by chance enter it, they will hardly increase at all, as they have little suitable nourishment provided for them, and will quickly decline in vigour, die, and become incapable of poisons." We believe there is a consensus of medical opinion on this point. Habitations, and the person, must, as a matter of course, be kept scrupulously clean; above all, "no fear should be felt, nor should the subject of cholera be constantly

thought or spoken of." Those who have lived in towns afflicted with this epidemic, and know what influence the mind exercises upon the body, should lay this advice to heart. An incubus hangs over the place, and it cannot be accounted for on any other ground, but that the suddenness of the attack, and the course it runs through in a short time, lend a further horror to the operations of this fearful disease. The next point Dr. King draws attention to, are clothes, which play an important part in communicating diseases. These should be carefully disinfected by saturating them "with a solution of perchloride of mercury after being placed in a tarred chatty, or in a tin box, or drum, with a close-fitting lid." This precaution is to be taken when conveying them through a town, or storage in a house pending disinfection. Destruction by fire of clothing which has been worn by those who have succumbed to the disease, or otherwise come in contact with them, is also recommended. The disinfection of corpses and their disposal is another subject that should be attended to. The cloth in which a corpse is wrapped should be saturated with carbolic acid, or perchloride solution, presuming that the inveterate obstacle 'caste' offers no barrier to the suggestion. As for the disposal of the dead, there cannot be two opinions on the subject. Cremation is the safest course, if properly conducted, and provided that the scriptural injunction—"Ashes into ashes, dust into dust"—is strictly and faithfully carried out to the very letter. Fire is a great purifier, and to fire should everything be consigned for which there is no further use. But prejudices are strong in the way of all sanitary reforms, and we say so with some hesitation and misgiving. It is impossible to accurately convey in the short space of a single article all the valuable information Dr. King volunteers on the subject. All we say is, let the *brochure* be translated into all the vernaculars, and distributed as widely as possible under the patronage of the Government of India.

HILL RAILWAYS.

THE prospects of Indian Hill Railways seem to be looking up somewhat. We hear that the Umballa-Kalka line will shortly be commenced, justification for it, in the teeth of Government's everlasting financial pressures, being found in the fact that it is necessary—or at any rate very desirable—as a military line. The idea is, at present, to carry it as far as Dhurrumpore, and by such means to put Dugshai, Solon, Kussowlee, and Subathoo and some 3,000 European troops stationed at those places within three or four hours reach of Umballa, and main lines of railway connection with all parts of India. Anglo-Indian statesmen have learnt by experience that in India "nothing happens but the unforeseen," and are aware also that a readily available contingent of 3,000 European troops, braced up in constitution, and restored to pristine energy by recuperative hill residence might well be reckoned on, to turn a dubious war scale on occasion. Clive at Plassey, Wellington at Assaye had nothing like that number of European troops to depend upon. There were times during the Indian Mutiny when Lord Clyde,

General Havelock, Sir Hope Grant, and other English Commanders of that time would willingly have sacrificed their right hands to secure the aid of such a contingent as is now available in the hills north of Dehra. For the rest, the cost of an Umballa-Kalka line is not in the nature of things, of the country to be traversed, that is to say, likely to be heavy; and experts have estimated that the traffic returns will prove remunerative.

The Nilgiri Railway is another hill line on the tapis. The difficulty of successfully floating this undertaking on commercial tides lay, we are told by a Madras paper, in the fact that it could not at first be thrown on the London Money Market on account of the Company promoting it being domiciled in India, and technical difficulties arising therefrom, under the Indian Companies Act. The Local Government would give no help towards removal of the legal obstructiveness; but Mr. Woolley, one of the promoters, was not the sort of man to allow himself to be beaten by red tape, and promptly had himself conveyed to London, to do battle with the chimera. Happily, Messrs. Willie Grant and Sheppard of the Madras Bar, happened to be there on a holiday, and the trio set to work with a will on their railway scheme, argued its cause with the Secretary of State for India and his legal advisers, argued the supposed legal difficulty off its legs and into the limbo of waste-paper baskets, triumphed all along the line. With result that the Nilgiri Hill Railway scheme is now being launched on the London Money Market under favorable auspices, and is likely soon to be an accomplished fact, in spite of red tape and Bumbledom. One of Goethe's maxims runs:—"In art and science no less than in action, everything depends on the object being clearly apprehended, and treated conformably to the law of its nature." It should not be forgotten that, to the perseverance of Mr. Woolley it is due that the Nilgiri Hill Railway scheme has been clearly apprehended in the proper quarters, and is now in a fair way to conform with the law of its nature. *Magna est veritas et prevalebit*, says the saw. What is perseverance but energetic insistancy on truth. What is truth worth in this bustling incredulous nineteenth century without perseverance to back it? We commend the moral of Mr. Woolley's worthily successful enterprise, to promoters of railways all over India. Practical, earnest endeavour counts for more now-a-days, and has far more practical effect, than weeping, and lamentations and abject woebegonenesses.

The Dehra Dun Railway is a third hill line, or quasi-hill line, now getting galvanized into new life, after a long trance. For nearly a decade a railway intensioned to revive the somewhat faded glories of Mussoorie has been talked about, and exploited more or less. If householders and owners of property at that pretty Himalayan retreat had been energetic, and willing to put their hands into their breeches pockets, it might have been an accomplished fact long ago; before the line to Darjeeling was thought of. It would have been worth their while to be energetic. Mussoorie is a charming place, and its beauties and *agremens* have always been recognized by Anglo-Indians meditating short leave and holding coun-

cil with themselves where to spend it. But then there is the getting to it. An awful, formidably deterrent "but" in these days of easy comfortable travelling, to other holiday resorts; a "but" involving fifty miles, miles of jolting and shaking over a rough road, in a ramshackle conveyance, at the mercy of unbroken tattoos and demented drivers—and paying for the discomforts at the rate of about a rupee a mile. Time was when the Anglo-Indian on leave regarded such discomforts as necessary evils, and submitted to them as such, letting off steam from his corrugated bilious system, every now and then, in letters to the Editor of the *Madras Mail* or the *Delhi Gazette*. But that time has long gone by. Odious comparisons hinging on the comfort attainable by travelling in other directions have diverted alike grass-widows and likely spins, Colonels and Civilians, from Mussoorie to more eligible, simply because more easily accessible, health and holiday resorts. There is still balm in Gilead, however, hope for Mussoorie in the future, fair prospects of the speedy construction of a railway connecting the Oudh and Rohilkund line's extension to Hurdwar with Rajpur, at the foot of the hills, and only six miles instead of fifty from the desired haven of rest and recreation.

Government has been prevailed on to make certain concessions in connection with the Dehra Dun scheme, and engages:—(1.) To repay the cost of preparing the project up to a limit of Rs. 10,000, in the event of the Association failing to establish a company to construct the railway. (2.) To give land free of cost under the same conditions as have ruled for the Bengal and North-Western Railway Company. (3.) To give a postal subsidy for the carriage of mails, the amount to be determined hereafter, and to be based on the actual expense incurred in doing the work. (4.) Government will do its best to promote a fair agreement for working the line between the Dehra Dun Railway Company, and the Oudh and Rohilkund Railway, or whatever agency may be working the latter line when the Dehra Dun Railway is completed. (5.) The Government of the North-Western Provinces and Oudh will endeavour to provide reasonable facilities for procuring such timber and other forest produce as may be required for and during the construction of the railway. This seems to us as liberal an allowance in the way of concession as any Indian Railway scheme has a right to expect at the hands of Government, or the promoters of any intrinsically solvent railway scheme would care to ask for. For it goes without saying that Government does not give its *quid* altogether without a *quo*.

Mr. Molesworth estimates that the Dehra Dun line will cost Rs. 84,000 per mile, to make. Messrs. Campbell and Hope, its thick and thin supporters, are of opinion that it can be constructed for much less. Its net revenue, when constructed, has been estimated by Major Gracey at a sum which would yield over 7 per cent. on capital outlay, even accepting Mr. Molesworth's estimate. We wish the scheme all the success it deserves. Its promoters are said to be sanguine of success, and are going to send someone to London to work financial oracles there, as Mr. Woolley has done for the Nilgiri Railway.

Notes and Comments.

THE DELAGOA BAY RAILWAY.—The first section of Delagoa Bay Railway was formally opened by the Governor-General of Mozambique on 15th December, amid great rejoicings.

DEFENSIVE PRECAUTIONS.—At a Council meeting in the Straits Settlements last month, there was passed a long-needed measure to prevent spies intruding into the local defences.

THE LOCOMOTIVE SUPERINTENDENTSHIP, E. I. R.—The announcement that Mr. Strachan had been appointed Chief Locomotive Superintendent of the East Indian Railway, *vice* Mr. Campbell, is confirmed.

THE PROPOSED GRAVING-DOCK.—The question of the respective advantages of Rangoon and Calcutta as a site for the Graving-Dock in connection with our Naval defences will probably be settled during Admiral Richards' stay in Calcutta.

"OURSELVES."—The *Indian Mirror*, which is the leading exponent of native public opinion, says:—We have received the last issue of the *INDIAN ENGINEERING*. It contains several interesting articles, and continues to be conducted with marked ability and discrimination.

IMPERIAL ROADS IN BENGAL.—A proposal is under consideration to make over all roads in the Presidency Division, Bengal, to Local Boards, and it is contemplated to eventually entrust the up-keep of all Imperial lines of communication in the Province to the same agency.

"INDIAN ENGINEERING."—We have been informed in an official communication from the Bengal Secretariat that the Divisional Commissioners have been requested to draw the attention of the principal Municipalities and District Boards in the Province to our articles on Artesian Borings in the Sunderbuns.

THE BENGAL P. W. D. RAILWAY UNDER-SECRETARYSHIP.—We learn on good authority that Mr. Brereton, Assistant Director, N.-W. Railway System, Karachi, has been offered Mr. Spring's post. Rumour will have it that the latter goes back to executive work—active employment on one of the N.-W. Frontier Railways.

SIR THEODORE HOPE AT AHMEDABAD.—Sir Theodore Hope condemned the old waterworks at Ahmedabad, and approved of the new ones, but advised the authorities to sound the well further by competent Engineers. He desired to see the tramway extended in the town, and drainage constructed outside the town.

THE SIND METAL MART IRON WORKS AND FOUNDRY.—We have been asked to intimate that the business heretofore conducted by the well-known firm of Harrower and Co., Kurrachee, has been transferred to Messrs. Mackenzie and Co., of the same town, who will in future carry on the *joint* business under the style of the "Sind Metal Mart Iron Works and Foundry."

THE SONE IRRIGATION SYSTEM.—At this juncture the following tribute to the Sone Canal works is of especial value:—"The whole system is perhaps as near perfection as anything can ever hope to be, and even the most casual observer cannot fail to be impressed with the admirable manner in which it is worked, or appreciate the energy and skill to which this Engineering triumph is due."

AN ITEM FROM RANGOON.—We are informed that on the Burma State Railway, the cast-iron buffer sockets for Jones' patent flexible couplings, as designed by Mr. Thomas, the Loco. Superintendent, have turned out a complete failure, as those on the mail train are going fast, and will have to be condemned. Nearly a thousand of these castings, weighing 36lbs. each, were made at the Insein Workshop. What a waste of money!

THE REPAIR OF THE COLOMBO WATERWORKS.—The people in Ceylon are very quiet over the waterworks. It is suggested that some one ask for the Commissioners' report? It is advised that those concerned should not allow any more money to be wasted at Maligakanda. £20,000 will *not* suffice for the restoration. Good independent inspection—by Hawkesley?—is needed. Bate-man is said to be too old to go out himself. It certainly is time that some such move was made.

WATER-RATES IN MYSORE.—Rs. 4 per acre when the irrigation is supplied wholly at Government expense from a Government river irrigation channel. Rs. 3 per acre for irrigation from a private branch channel allowed to be drawn from a Government river irrigation channel. Rs. 2-8 per acre for irrigation from a good Government tank or other irrigation work distributing water till about March. Rs. 1-8 per acre for irrigation from other inferior sources of Government water-supply.

ANOTHER STEAM TRAMWAY PROJECT.—The Collector of Kurnool has laid before the Madras Government a proposal of the District Board of Kurnool agreeing to a guarantee of 4 per cent. on the necessary capital required for the construction of a steam tramway from Kurnool town to Dhône, the nearest station on the recently opened section of the Bellary-Kistna State Railway, between Guntakul and Nandial. The tramway will be laid along and on the existing road, and is estimated to cost eight lakhs of rupees.

THE S. P. R. EXTENSION—AGAIN.—The *Pioneer* contradicts the statement made in Bombay that the Chaman Railway line is likely to be shortly laid to Kandahar. The statement is based on the inquiries for material, &c., which have recently been made. It has all along been intended to keep in Pishin sufficient rails and sleepers for the 70 miles from Chaman to Kandahar, to be used in case of emergency; but this arrangement has certainly not developed into a scheme for laying the line forthwith.

EASTERN BENGAL STATE RAILWAY ENGINEERING STAFF.—Mr. Anderson relieves Mr. Moore, but as Mr. Nicholson will shortly be out to take his old place, the wisdom of the present change might well be questioned. It would appear—since the "construction" works have been completed—that the "maintenance" of this system of lines affords a fine field for the "unemployed" staff of Government Engineers. It is in view of this fact, perhaps, that the Secretary of State refuses to sanction any further grant of "special leave!"

ELECTRIC LIGHTING IN INDIA.—We learn that an employé of Messrs. Siemens Brothers and Co., Engineers, has left England for India, in the P. and O. Steamer *Bengal*, to put up the electrical apparatus which that firm is supplying for the lighting of the new Viceregal Lodge at Simla, for which work Mr. W. H. Massey of Twyford, Berks, Electrical Engineer to Her Majesty, is Consulting Engineer. Nearly 1,000

glow lamps will be employed. The circumstance is noteworthy, inasmuch as this is the first Indian palace so lighted.

BOMBAY BOILER INSPECTION ACT.—Mr. R. Niccol, Superintending Engineer, British India Steam Navigation Company, and Mr. J. Bigmore, Superintending Engineer, P. & O. Steam Navigation Company, are gazetted Senior and Junior Members, respectively, of the Board of Examiners for the City of Bombay for conducting the examinations prescribed under the provisions of the Bombay Boiler Inspection Act. Something of this sort is sadly needed in Calcutta, where, strange to say, the Inspectors employed under the Boilers' Commission are not qualified men.

THE BAHAWALPUR-BATINDA LINE.—General Aeneas Perkins and Mr. E. E. Oliver start on their tour of inspection, which will, we believe, be confined to the route of the proposed Railway in the Patiala State. This long-talked of line will, we think, be in a fair way to become a reality: a result which will be all the more welcome, because we have little hope just now, of the larger, more direct and, though much more costly, infinitely more important proposal of a line from Bahawalpur to Delhi being seriously contemplated. Even the Military authorities, we understand, are not as yet convinced of the strategic advantages of that scheme.

A MUNIFICENT JUBILEE GIFT.—A Bombay Government resolution records a conspicuous instance of liberality on the part of Sir Dinshaw Maneckjee Petit, who has offered to convey to Government his property known as the Hydraulic Press in exchange for the Elphinstone Arts College buildings and adjoining land, which he will then convey to Government for purposes of the Victoria Jubilee Technical Institute. The value of the property is estimated at three lakhs of rupees. Government have intimated its acceptance of the offer, with gratification. Sir Dinshaw has also offered the sum of Rs. 1,25,000 towards the foundation of the lying-in-hospital in Bombay.

PALAMOW COAL.—Messrs. Hodges and Radford, the well-known contractors, who have their head-quarters at Dehree on the Sone, own and work the coal mines at Palamow. The coal is brought down by country boats and carts, and is consumed by their own steamers, and the Canal Department and workshops. The supply is practically unlimited, but the demand is small, and there are no proper means of carriage available. The opening out of the Benares, Palamow, and Cuttack Railway will, however, create the necessary demand. This coal is of excellent quality, gives great heat, and burns with little or no smoke—qualities which render it eminently suitable for locomotive and smithy purposes.

THE HOOGHLY AND ITS IMPROVEMENT.—The blue-book of 1885 indicates that the more obvious and heroic efforts of Engineering by dredging are not practicable in the Calcutta river. Mr. Leonard, from personal knowledge was quite convinced that the action of the most powerful dredge would be inappreciable on any one of the Hooghly shoals. The excavation made one day would be filled up before the next day's work commenced. Training works, spurs, longitudinal walls, and the narrowing of the channel have all been considered. But the report, by the Harbor Engineer for India, in the blue-book for 1885, concludes with the ominous words, "The river is not one for experiments."

ITEMS FROM HONG-KONG.—The report of the Hong-Kong and Macao Glass Company has been issued. The managers state that they endeavoured to sublet the works but without success. They recommend that the property be sold and the Company wound up.—The annual meeting of the Hong-Kong High-Level Tramway Company has been held. The managers state it was found advantageous to dispense with the safety rope and adopt a system of powerful brakes acting on a central steel rail. The opening of the line for traffic, they say, depends upon the completion of contracts terminating at the end of the year.—The Victoria Water works, it is expected, may be completed about the middle of next year.

COAL-PROSPECTING IN UPPER BURMA.—For the present, and until the question of railway construction in Upper Burma is somewhat more advanced, the Government of India would prefer not to alienate its rights in coal deposits. Any licenses therefore which may for the present be given will be granted on the understanding that they confer no right to a concession hereafter, and that if, as may or may not be the case, the Government of India decides to grant concessions, they will not be allowed to take the form of monopolies. The Governor-General in Council doubts whether any of the applicants will care for licenses to prospect under such circumstances, but the Chief Commissioner is authorized to grant them to applicants approved by himself.

PUDUKOTA P. W. D ADMINISTRATION.—During the last nine years of Mr. A. Sashiah Sastriar's administration of the Pudukota State, the expenditure on D. P. W. amounted to Rs. 5,85,596, of which Rs. 1,31,793 were on irrigation, Rs. 2,61,698 on roads, and Rs. 1,92,105 on buildings. In the report for the year (1886-87) ending 30th June 1887, we learn that the Dewan-Regent has procured the services of Mr. Wilks, M.I.C.E., as a Civil Engineer, for a term of four years, to be renewed for such further period as may be found necessary. The outlay on work executed during the year under report was as follows :—

On Irrigation works...	... Rs.	8,066
On Roads ...	... "	20,357
On Buildings ...	... "	19,151

A POLYTECHNIC INSTITUTE FOR BENGAL.—We learn that the Committee that has been sitting to decide the future of Seebpore Engineering College, have decided that it would serve a more useful purpose if it were modelled on the lines of the Poona College of Science. It is suggested that the College should be divided into different departments, in which Agriculture, Chemical Industries, Mechanical Arts, Mining, and Engineering would be imparted. Engineering would, as in Poona, form the back-bone of the Institution. We think a class for Architecture embracing "Design" very desirable, and have no doubt that its value will be recognized in the scheme now being formulated. We are afraid that Mr. Spring's hopes stand but little chance of realization. The measure likely to be adopted will be more general, more useful, and more practicable.

SOMETHING OF THE SORT WANTED.—We endorse the views of the Lahore paper anent the Patents Bill, which will be passed into law before the close of the Calcutta Session. When the new law comes into force it might be well to consider the advisability of establishing a distinct Patents Office which would have at its head an expert who would be able to deal with all specifica-

tions of inventions coming before him. We believe the Government derives a not unimportant revenue from the sale of stamps which are required by the law to be fixed to all applications for patents, and could well afford the appointment of a first-class man for the working of an Imperial Patents Office. The present arrangement under which a Secretariat Department administers the work does not give unqualified satisfaction; and a change, such as that suggested, would be a move in the right direction.

QUARTERLY INSPECTIONS OF THE KIDDERPORE DOCK WORKS.—We are in receipt of the Second Report from Messrs. Wickes and Cloete, to the Government of Bengal, Public Works Department, including a tabular statement and index plan, submitted by the Superintending Engineer of the Docks, to shew the work done during the quarter ending, and the total amount executed from the commencement up to, the 30th September 1887. It must be remembered that this report has reference to a time when the works were necessarily retarded by the rainy season and by the annual Doorga Poojah holidays. The progress was consequently much less than in the previous quarter, but was greater than the Superintending Engineer in charge of the works had anticipated. The condition of the works on the 30th of September last was as briefly described in our issue of the 31st December 1887.

THE GOVERNMENT COAL-MINES IN THE CENTRAL PROVINCES.—We were not a little surprised to find from the last *Gazette* that Mr. J. A. Maughan has been appointed Manager of the Umaria and Warora Collieries and Bilaspur-Etawa State Railway. The questions that naturally arise are—What has become of Mr. C. Z. Bunning? Are the claims and qualifications of Mr. Maughan—an outsider—so great as to warrant his being brought in to supersede older officers? Government mining in the Central Provinces has been on the whole unfortunate, and we are afraid that with the procedure now adopted, and the appointment of Mr. Maughan, that there is but little hope of all the improvement that could be desired, and this apprehension is not diminished by the fact that it was during Mr. Maughan's management that the Nerbudda Coal Mines proved a practical failure.

THE SIND-PISHIN RAILWAY EXTENSION TO CHAMAN.—The following particulars are furnished by the *Pioneer*:—The line at present runs to Killa Abdulla, and thence it will be carried parallel with the bed of the Khojak stream up the hillside until the zig-zag road is reached. From about this point a tunnel will be driven through the hill, its exit towards Chaman being at the foot of the zig-zag on that side near the well-known nalla. As the descent here is very steep the line will have to be carried along the hillside for a very considerable distance and will then double back, so as to reach Chaman without any very stiff gradients. The Engineers are sanguine that the work can be completed in two years, but the time to be consumed will largely depend upon what the "core" of the range is found to be. We may, in any case, trust Mr. O'Callaghan to do all that is possible where Engineering skill and science are concerned.

GOVERNMENT SERVANTS AND THE PUBLIC PRESS.—Much misapprehension exists on the subject of Government employes contributing to periodicals and journals,

and quite recently a correspondent to a contemporary enquired, through the columns of that paper, for the number and date of the *Gazette of India* in which a resolution was said to have appeared as having been passed by the Governor-General in Council, to the effect that Government employes "are not prohibited to contribute to the press except on certain specified subjects." It is authoritatively stated that no such prohibition exists. The only restriction is that no Government official, writing for the press, should be permitted to make use of any confidential information acquired by him in his official capacity for the purpose of his writings. A Lieutenant-Governor of Bengal, whose authority is referred to above, even went so far as to say that he "rather approved of officials writing to the press, though, of course, much depended on what they wrote."

VOLUNTEER HEAD-QUARTERS BUILDING, CALCUTTA.—The construction of these Head-Quarters has already been hanging fire for a considerable time, and the Building Committee seem to be in a corner. Mr. Garlick originally prepared designs, first for a permanent and afterwards for a temporary structure, the iron work for which was ordered through A. & J. Main of Glasgow (costing about Rs. 17,000). Immediately after, however, a new idea seemed to have been started for building permanent Quarters, and the permission of the Commander-in-Chief had to be sought—with what result is not yet known. In the meanwhile, a Mr. Palmer of the E. I. R., has stepped in and submitted a design, and apparently Mr. Garlick's has therefore been shelved. The question of the course which should be pursued in the design of buildings in which the public have an interest is one that requires to be settled, for there is something very haphazard and not very encouraging to those who gain a livelihood by it in the way in which things are now carried out.

MINING IN MAISUR.—In an official order just passed the Dewan of Maisur observes that the occupant of Government land included within a block leased for mining purposes has a right to the full enjoyment of the surface of the land and its produce. Such right can only be determined by contract between the mining lessee and the occupant. The latter, however, has no right to the minerals, but he has the right to prevent entry upon his land or any disturbance of its surface. The lessee will therefore find it always to his advantage to enter into some early arrangement with the occupant, but the Government have no wish to insist upon such an arrangement being made. The occupant, on the other hand, is in the first instance liable to Government for the land revenue. If he fails to pay it, and it is not paid by the mining lessee also, the land is liable to be sold for arrears of revenue. If the mining lessee desires it, the particular land in default will be proceeded against and put up to sale in due course. But the Dewan cannot instruct the local authorities to bring any pressure to bear upon the defaulting occupant.

MADRAS IRRIGATION AND NAVIGATION WORKS.—The financial results for which Capital and Revenue Accounts are kept, for 1886-87 shew that the surplus revenue derived from Major (Productive) Works during 1886-87, after paying working expenses and interest charges, was £121,348, or £10,796 more than that of the previous year, chiefly owing to extension of irrigation and reduction of the cost of maintenance in the Godavari delta. The revenue derived from the Kistna delta and the

Sangam anicut project increased by £3,520 and £1,952, respectively, while that from the Kurnool canal decreased by £1,971. The cost of maintaining the Cauvery delta and the Kurnool canal was reduced by £4,352 and £671, while that of the Kistna delta and the Sangam anicut project was £3,276 and £2,207 less than in the previous year, respectively. The revenue from Minor Works and Navigation was £3,422 more than the working expenses, against a deficit of £18,198 in the previous year, during which large sums were spent in restoring the Red Hills tank and repairing flood damages to other works. The only Protective Work sanctioned is the Rushikula project, which is still under construction.

FIRES AND THEIR PREVENTION IN BUILDINGS.—The end of the world, and advent of that glad apocalyptic time Dr. Cumming used to prophesy must surely be near. What else could make Bombay modest? It is written in the Local Gazette of the 18th ultimo, *apropos* of the burning of the Allahabad Secretariat:—"In Bombay we have fire engines and trained firemen; but there is no pretence of having the means of coping successfully with the great conflagration. Whenever a mill takes fire it burns from roof to basement, until it is destroyed." Mr. Lambert orders affairs better in Calcutta. But he cannot live for ever; and how long is science going to be in devisement of some warrantably cheap and efficient means for guarantee against combustibility in our public buildings? Exeter and other late lamentable accidents in England and on the Continent notwithstanding a fire in a theatre usually does more damage to theatrical wardrobes and stage properties than to anything else; is a mere monetary loss, more or less easily remedied. But lost records are sometimes disasters as irremediable as the destruction of the Alexandrian library was in the days when the world was young, and unscientific for the most part. It behoves a century that vaunts its light and leading to devise some chemical or other quickly available insurance against fire.

THE IMPROVEMENTS AT MELBOURNE HARBOUR.—An important section of the works designed by Sir John Coode for the improvement of the harbour accommodation at Melbourne has just been completed. The bend in the river below that city, known as "The Fisherman's Bend," has long been an obstacle to free navigation, and the straightening cut made has tended greatly to facilitate it. Not alone does it remove many of the difficulties attending tortuous navigation, but it furthermore absolutely shortens the distance to be traversed by ships fully two miles between the sea and the wharves at Melbourne. But perhaps the main advantage gained, is to be found in the fact that, whereas hitherto it had not been practicable to bring vessels of any size up to the city, the new channel, coupled with the improvement effected to the leeward of it, will now enable vessels of the largest size to reach Melbourne and discharge their cargoes in proximity to its warehouses. The new channel by which these advantages have been obtained is 2,000 yards in length, its low-water width being 260 feet; its present depth is 18 feet at low water, but the depth which it is intended to form ultimately, when the docks it is in contemplation to construct at Melbourne are built, will be 26 feet. The citizens have decided upon an early commencement with a portion of the general recommendations made for dock accommodation by Sir John Coode, modified, however, as to the constructive material to be used in

accordance with suggestions made by the local engineering adviser.

OUR X'MAS PUZZLE.—The *Civil and Military Gazette* says:—In an article on the Dufferin Bridge our contemporary the *Pioneer* remarked that Engineers had to carry on their work, often under great difficulties and even danger, without hope of ribands or other decorations. The recent List of Honors shows that this is not quite the case, and has caused us to reflect on the system on which such rewards are distributed. We confess that the puzzle is beyond us, and, following the usual Christmas custom, we present it for solution to our readers as something on which to exercise their ingenuity during the winter evenings. It would appear to us that "the punishment does not always fit the crime;" but perhaps some of our readers will be able to furnish a clue to the difficulty:—

- | | | |
|---|---|-------------|
| For building a large bridge. | } | C. I. E. |
| For superintending irrigation. | | |
| For managing a large railway. | | |
| For inaugurating the whole State railway system of India, including every detail of construction, and advising the Government of India on most Engineering questions. | | |
| For constructing a temporary line up a river bed liable to be washed away two or three times a year. | } | C. S. I. |
| For constructing a large bridge and managing for many years a large railway. | | |
| For advising the India Office on Engineering matters. | } | K. C. I. E. |
| For lavish expenditure on construction of a railway, including many Engineering absurdities and leaving it unfinished. | | |
| | | K. C. S. I. |

A GOOD EXAMPLE.—It has been suggested by an English contemporary that the next Arctic Expedition will very likely be conducted by rail, instead of aboard ship. Russian Engineers, we are told, are fast pushing on a railway line at the head of the gulf of Bothnia, with the North Pole, or somewhere there or thereabouts for terminus. When last heard of in clubs and haunts of London civilization this line had been completed to within four miles of the famous Gallivora mountains. The first train that ran on this most northern railway in the world passed the Arctic Circle some two months ago. Holkar and other Indian princes, with conservative John Bull prejudices to back them, have inaugurated a fashion of sneering at and contemning Russia, and anything and everything emanating from the Czar's Chancellerie. It is an unwise, un-nineteenth-century-like prejudice; short-sighted and suicidally tending. From an engineering point of view at any rate it is worth while considering whether Russia's railway propaganda is not worthy and desirable of imitation by England. Peter the Great dreamt of a world of conquest acquired by force of arms. The traditions of conquest live still with his descendants; but 19th century facts have transmuted them from mere blood-thirstiness and greed of territory into a methodized trade system. Now-a-days, Russian diplomatists understand thoroughly, and are quick to take advantage of the engineering opportunities that serve them better than warfare. They carry on their propagandas through trade agencies and thereby advantage themselves and their interests in a fashion our "nation of shopkeepers" fails to apprehend. *Fas est et ab hosti doceri.* Great and wonderful although it is, our latter day, 19th century cannot afford to forget either the wisdom of the ancients, or the teachings of the present time.

Current News.

LIEUTENANT HEMMING, R.E., has arrived at Karachi from Simla in order to inspect the harbor defences.

SIR A. LEPPOC CAPPELL, Director General of Telegraphs in India, goes home on leave early in March.

THE Calcutta International Photographic Exhibition was opened in the Indian Museum on the 18th instant.

MR. MEDLICOTT, the recent head of the Geological Survey, will probably be granted a special pension of Rs. 6,000 a year.

M. SYAD ALI BILGRAMI, Inspector-General of Mines, Hyderabad, will shortly proceed on tour to the diamond prospecting fields.

THE office of Mr. Peter Scott, Superintending Engineer, Southern Mahratta Railway, Mysore Extension, has been duly opened at Arsikere.

A FIND of good coal is reported from the south of Kashmir. An officer of the Geological Survey will be deputed to report on the discovery.

CAPTAIN M. C. BARTON, R.E., has been appointed Superintendent of Instruction at Roorkee, and Captain P. T. Buxton, R.E., Company Commander.

IN accordance with the wishes of the Government of India, returns will be compiled from the Punjab, of districts in which "reh" and "usar" occur.

THE services of Mr. Field and Mr. O'Brien have been, with the sanction of Government, transferred to the Irrigation Department of the Patiala State.

THE station of Sambhu, on the North-Western Railway, was completely destroyed by fire on the 5th instant. The records, stationery, &c., were also destroyed.

A CONFERENCE of military officers is now sitting in the Garrison Engineer's office, Fort William, to consider the desirability of the re-distribution of public quarters inside the Fort.

THE P. and O. Company have leased the Hydraulic Lift at Hog Island, Bombay Harbor, from Government, for five years, the recent experimental operations having been successful.

THE four-masted ship *Walter H. Wilson*, which arrived at Calcutta some time ago, brought one of the largest petroleum cargoes ever shipped from New York. Over 203,600 cases were landed.

EVERY probability is now said to exist of the Suni bridge over the Sutlej being soon an accomplished fact. The *Simla Argus* is informed, on excellent authority, that the construction also of the cart-road to Budji will be early taken in hand.

LATEST advices shew that the Indian Midland Railway will be opened as far as Jhansi on the 1st February, from which date, we understand, the Great Indian Peninsula Railway will hand over the working of the Bhopal State line to the Indian Midland.

IT is rumored that the Railway Company contemplate the grant of a bonus to the principal employes on the Dufferin Bridge. Such an act would be an acceptable boon to the many who are still unemployed, as well as a graceful recognition of the arduous labours of the subordinate staff.

IT is understood that, owing to the further deputation of Dr. Schlich as Professor of Forestry at Cooper's Hill College for a term of two years and two months from November last, Mr. Ribbentrop, who has been and is acting as Inspector-General of Forests is to be appointed *sub. pro tem.* to the post.

OWING to the present accommodation at the Perambore Workshops, Midland Railway, being found insufficient to shelter the large addition to the rolling-stock of the Madras Railway that is about to be constructed, a sum of Rs. 20,000 has been allotted for the immediate erection of sheds for the rolling-stock while under completion.

THE section of the Calcutta Municipal Act which exempted machinery from rating, was omitted from the Bill now before the Legislative Council of Bengal. This was not approved by the industrial community, and the section has been re-inserted in the Bill, a course that will be satisfactory as being in accordance with a correct principle.

THE Board of Directors of the South Indian Railway have instructed their Agent in India to have at once prepared the necessary land plans, estimates, &c., for the proposed line of railway from Villupuram to Paikal in view to the construction of the same being proceeded with as rapidly as possible after receipt of Government sanction thereto.

COLONEL THOMASON, Superintending Engineer, Indore, goes on three months' privilege leave preliminary to his retirement from the service in May next. He would have been succeeded by Colonel Gibbs, Executive Engineer, Mhow Division, had not the latter sent in his name for furlough. It is not yet known who will get the post.

IT was originally proposed that the section of the line between Kazipett and Dornakul and the mineral branch should be handed over to Mr. C. B. Dunlop, District Engineer of the open line, but as no sanction has been obtained yet for the construction of the

line between Kazipett and Chanda, Mr. H. B. Molesworth has been allowed to retain charge of the line till such time as the Board of Directors accord their sanction for further operations.

IT is rumored that the head offices of the Southern Mahratta Railway will be established in Poona, instead of as intended in Dharwar. It is believed negotiations are in progress between the Company's officials and Government for the purchase of the condemned barracks at Ghorpurie. If these negotiations terminate successfully, the Railway Company intend to entirely renovate the barracks, and convert them into suitable quarters and offices for its staff.

A SUM of 1½ lakhs of rupees has been sanctioned and orders issued for the commencement of preliminary operations in connection with the Peryaur project. The project which is a gigantic irrigation one, is the conception of Colonel Pennycook, R.E., and that officer shortly proceeds to England to select and dispatch the necessary plant and machinery required for the work connected therewith, and is to return to Madras by the end of the official year, so that the work may be put in hand at the beginning of the next official year.

Letters to the Editor.

[The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

INDIAN COAL FOR OCEAN STEAMERS.

SIR,—In continuation of my previous remarks, I now beg to point out that the end to which the development and extension of the Indian coal trade will lead may be gathered from the history of the material and monetary progress of England and other European countries.

THE geographical position of India presents immense advantages to the extensive steam navigation between the Cape of Good Hope and Japan,—the Dutch Archipelago not excepted,—by reason of the cheaper transport from the Indian mines, as compared with the export from England and Australia. Statistics shew that the export in 1885 to the above named ports amounted to 2,000,000 tons whilst during 1886 about 230,000 tons came from Newcastle, N. S. W., and Sydney. Thus it will be clear that the coal from India will find markets requiring about 2½ million tons,—a prospect which should encourage the working of the existing mines on a larger, and therefore necessarily cheaper, scale, and induce adventurers to devise a plan which when carried out will realise results commensurate with expectations.

FURTHERMORE, the Bengal and Assam coals should especially find markets at Bombay, Ceylon and Burma and other ports where they could successfully compete with, and even oust, the English and Australian coals. The chief question to be considered is not the coal, but the freight; and for this reason the position of Calcutta is a matter of the greatest importance. The freight from England and Australia to the above mentioned port often fluctuates considerably according to circumstances. The vessels with coal cargo from either England or Australia take from three to four months to reach the ports of discharge. I would suggest that tonnage for Indian coal exports be provided by steam colliers of sizes most economical, such as those plying between the Tyne and London, Cardiff and the North of France, which return to the loading port without delay in water-ballast. The freight from the Tyne to London, 200 miles, occupying 30 hours, amounts to 4s. 6d., consequently the freight from Calcutta to the various ports—distance from 500 to 700 miles—will hardly exceed 6 to 7 shillings per ton, the loading and unloading charges being constant factors. In this manner Bengal coal could be placed at the various ports, distance 600 to 1,400 miles, at a freightage cost of 6 to 14 shillings per ton. A well organised fleet of steam colliers, reduced rate of rail freight, and a concession from owners of such collieries in tonnage freight for ports giving return cargo, should crystallise into existence what has hitherto appeared to be imaginary and impossible.

AN INDIAN COLLIER.

BHAGALPUR WATERWORKS.

SIR,—Referring to your articles on the above subject, I beg to point out—1st.—There are two waterworks at Bhagalpur; one for the Central Jail, having its pipes, engine and tanks separate from the Municipal waterworks, a report on which has been commenced to be published in your Journal.

2nd.—The latter waterworks, the more important one, have brought water up to the Commissioner's house, and there it has at present made a dead halt for want of funds to go on, for which reason also the rate-payers are being threatened with a water-rate, though they are very far from the prospect of getting any water for some time to come.

3rd.—Meanwhile the Executive Engineer is busy in rendering explanation for having exceeded the estimate even before the works are completed.

4th.—With the originator of the waterworks, as Chairman of the Municipality, the tax-payers may be pretty sure of being saddled

with a heavy burden for completing the waterworks, which as yet has conferred upon the town no commensurate benefit; and as there had already been in existence the Central Jail waterworks the idea was more a borrowed one than an original conception.

Sth.—Going into professional questions, one may be struck with the great height to which the water has to be raised. The difference of level between the low water and bottom of service reservoir is (173—80) 93 feet. The report gives no calculation of horse-power necessary to raise water enough to this height for a population of 66,000 souls from whom a water-rate will be soon demanded. Mr. A. Ewbank would do a service to the people of Bhagalpur by going into the necessary calculation for this purpose. Great apprehensions are entertained as to the possibility of the engines fulfilling the expectations. The waterworks were commenced as a charitable work. Should it prove to be an engine of taxation instead of an engine of good water-supply charitably given, what a sad commentary it would be on human intentions and Government action!

Mr. Editor, it is one thing to confer a real blessing on the people and another thing to make a show of it. The residents of Bhagalpur living near the river at present get clear water from the main stream at one pice a *ghyla*. During the flood season they have simply to filter the water. Like the husband of two wives the head of our Government has not the power to make any two jealous departments work together harmoniously. Had he such power he could have contrived to expand the Central Jail waterworks into a scheme for supplying the European houses which lie on the elevated portion of the town, and the rest of the town could have been supplied from the Chanun, a hill stream close by, from which water could be got at a cheap cost.

January 13, 1888.

OBSERVER.

A HARDER CASE.

SIR,—I have perused Mr. Salt's letter in your issue of the 31st December 1887, and I most heartily sympathise with him in his grievances in connection with the cruel treatment meted out to him by the Chief Engineer of the Southern Maharatta Railway. This is, however, not the first instance of the Chief Engineer's unjust and tyrannical treatment of his subordinates. In October last I was made aware of a harder case than Mr. Salt's, and now that Mr. Salt has been the first to come forward with a public exposition of his case, I don't see the reason why this one should not also be ventilated through the columns of your esteemed Journal. I say *harder* advisedly, because there was less excuse for dismissal, and that it affected a most trusted and deserving member of the Engineering Staff, one who for 16 months worked most indefatigably for the interests of the Company and whose honesty, integrity and steadiness were more than once eulogized by his superiors. This gentleman was transferred from the South Deccan Line to the Mysore Extension; he was posted to a wilderness where he could get neither food nor water; he was obliged to send seven miles once a week for common articles of food, and two miles daily for drinking water; he could get no domestics to serve him in such a place and he was 150 miles from medical aid. After being three months in this hole he fell ill with fever, and had neuralgic headache. He applied for a transfer to any other place, irrespective of distance, giving his full reasons for the request made; and at the same time offered his willingness to defray his own expenses, as well as the expenses of the party who may be sent to relieve him. I leave you to imagine then this gentleman's surprise and disgust when he received a reply to his application—through the Superintending Engineer—to the following effect:—

"Give Mr. ——— a month's notice that his services are no longer required."

On receipt of this stricture Mr. ——— wrote to his late South Deccan Executive Engineer, who knows him well, setting forth his grievances and asked him to intercede in his behalf, especially as he had a large family of eight children solely dependent on him, and that he had committed no departmental offence to have merited the iniquitous decision of dismissal. Mr. Scott replied in the following words:—

"I am exceedingly sorry for what has happened in your case, and more sorry still that I cannot avert the trouble. I heard of it in Dharwar before I left there, and knowing you as I do, I took the opportunity to speak to Colonel Lindsay in your behalf, but I regret to say he would not withdraw the order, although I said I would vouch for you that you would not give any trouble after I took over the Division.

"As you say, it is very hard on you, for when you worked under me you were always most attentive and never spared yourself when there was work to be done. I should have been only too glad to have an Inspector I could trust on my Division, but unfortunately Mr. Bayers took exception to your request for a transfer and reported the matter to the Chief, who issued the order that your services might be dispensed with." * * * *

Now Sir, is it at all encouraging to men of any respectability to accept employment on the Southern Maharatta Railway—employment that is only transitory? Surely it would be far better for those who have a sure half-loaf elsewhere to take warning and not relinquish it for an uncertain whole one on the S. M. R.

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Literary Notices.

THE ASYLUM PRESS ALMANACS. MADRAS.

THE "Annuals" for 1888 issued by the Lawrence Asylum Press, Madras, maintain the reputation of those of previous years, not only as regards mechanical excellence, but in respect to affording useful information in a convenient form. The *Pocket Almanac* is in advance of anything of the kind as yet issued in India. It is well suited for an Engineer's Diary. The larger *Almanac* is, as its title implies, a "compendium of intelligence" on the same plan as its predecessors, but with some noticeable new features, which cannot fail to render it more valuable as a work of reference. Each of these publications contains a Map which works with a List of Residents or Places so as to enable the position of the latter to be ascertained at a glance. The names on the Civil Service List have the "Literary Work," if any, of the Members subjoined to their "Services." The Public Works Distribution Return is corrected up to date. We should like to see the Local Fund Public Works Establishments given in future issues.

PROCEEDINGS OF THE ASIATIC SOCIETY OF BENGAL.

No. 1. for November, 1887, contains an Abstract of a Memoir on Plane Analytic Geometry, By Asutosh Mukhopadhyay M. A., F. R. A. S., F. R. S. E. THE object of the author has been to bring together a number of theorems and methods in Plane Analytic Geometry which have accumulated in his hands during his study of that subject; some of the easier of these propositions have already been given in the author's Lectures on Analytic Geometry, now in course of delivery at the Indian Association for the Cultivation of Science; a few have been published elsewhere without demonstration; most of the theorems, however, are here given for the first time. The paper now printed contains the first thirty-two sections of the memoir, which, when completed, will, in addition to the sections now printed, contain theorems on Elliptic Coordinates, Elliptic Inversion, and other analogous subjects. The paper, so far as it is at present ready for publication, will be published in full in Part II. of the Journal for 1887.

RECORDS OF THE GEOLOGICAL SURVEY OF INDIA.

PART IV., for November 1887, of these Memoirs is rather late to hand, but the contents of the number more than atone for the delay.

Mr. R. D. Oldham discusses some points in Himalayan Geology without adding anything to our positive knowledge of the subject.

Mr. Middlemiss describes some Crystalline and Metamorphic Rocks of the Lower Himalaya both as regards their relation and composition, and clenches the argument for the great age of gneissore granite.

Mr. Bose's Note on the Iron Industry of West Raipur is a valuable contribution to the Economic Geology of that region. He says:—

The richest and most extensive ores of the district are to be found in the Daundi-Lohara zamindari. Furnaces exist at *Killakora*, *Ungara*, *Hirkapur*, &c. The hill of Dalli, for about 7 miles of its length, is full of good hematite, which is developed in hard, red, rather thin bedded ferruginous Chilpi sandstone. The villages of Dalli and Kondekassa once possessed a very large number of furnaces, but they have been given up, owing to the Zamindar of Lohara having raised the duty levied on iron furnaces.

Four specimens of the ores were analysed by Mr. E. J. Jones, of the Geological Survey, with the following result:—

Percentage of iron.				
1. Dalli	...	...	...	72.92
2. Do.	...	...	...	67.41
3. Chutrala	...	...	...	63.82
4. Worarband	...	...	...	53.24

The first variety of the Dalli ore appears to be the best that has as yet been found in this country, as will be seen from the following comparison:—

Dalli. (Raipur.)	Lohara hill (Chanda.)	Agaria. (Jabalpur.)	Sanfow. (Rajputana.)	Dechaun (Kumaon.)
Percentage of iron 72.92	69.208	68.38	66.90	55.13

All the places mentioned above, except Magarkund and Worarband, are situated in fairly wooded forests; and those near Dalli, especially to the west and south-west of it, are exceptionally good, so much so that a charcoal furnace on a large scale could possibly be maintained here to advantage. The fuel used for reduction of ore in the furnace is obtained from *Dhaora*, *Salai* and similar trees of comparatively little economic importance, teak and other timber-yielding trees being not allowed to be cut down for the purpose. For refining, bamboo charcoal is employed.

Of all the places tabulated above, Dalli is most advantageously situated as regards supply of water, several springs in the neighbourhood yielding it in a very pure form. Mr. E. J. Jones of the Geological Survey, who analysed a sample of the spring water, detected the merest traces only of lime and chloride in it.

Flux is never used in the furnaces. The Raipur (Lower Vindhyan?) limestone is usually not far off from the iron-ore localities. As regards Dalli, the nearest outcrop of it is at a distance of 20 miles. One specimen of the stone, analysed by Mr. Hiralal, of the Geological Survey, gave the following result:—

Carbonate of lime	...	83.50
" " Magnesia	...	2.00
Oxide of iron and alumina	...	0.90
Insolubles	...	13.60
		100.00

The furnaces are of a primitive character, not unlike those described at page 380 of the "Manual of the Geology of India," part III. The ore selected is almost invariably the softest, though not always the best, available. The metal turned out by the furnace is refined in an open hearth, and is made into bars called *chuls*, which are sold to blacksmiths at an average rate of five annas per *chul*. The outturn per day from each furnace, supposing eight persons to be employed for preparing and bringing fuel and ore, and for working at the bellows, would be four *chuls*, selling at one rupee four annas. Fixing the wages of work-people at two annas per head, this leaves a margin of four annas for the proprietor. The duty on the furnace has to be paid from this sum, and it may be as low as one rupee, and as high as seven rupees per annum. This, however, is inclusive of all dues on account of trees cut down for charcoal. As the only expensive portion of the apparatus employed is the bellows, which costs from three to four rupees, and as the proprietor's supply of laborers is usually drawn from his own family, he being one of them, iron-smelting is considered a fairly profitable industry where fuel is abundant, and the duty on the furnace not too high.

The furnaces are worked by a class of Gonds who style themselves *Agarias* or *Pardhans*. They almost invariably speak the Gondi language, which their brethren of the plains have quite forgotten, and would not scruple to eat cow, buffalo, &c., which the latter, who aspire to the title of Hindus, would never touch. Iron-smelting must be a very old industry with the Gonds. Their traditions ascribe their first settlement in *Kachikopa Lahugarh*, or the "Iron Valley in the Red Hills," and the only metal for which they appear to have a name in their language is iron.

We have already reviewed Mr. Jones' investigations in Upper Burma.

Dr. King's second notice of Boring Exploration in the Chhattisgarh Coal-fields is epitomised by himself. He says:—

In my previous notice it was shown that, owing to the poor quality of the coal from the boring assays in the Rampur field, examination should be diverted to the Mand Valley, and, if possible in the time at our disposal, to the Korba country also. These later explorations have been made, with, however, no better success.

Colonel McMahon furnishes some more remarks on Microscopic Petrology, and, judging from the list of 23 Papers which he has contributed at various times to the "Records" on allied topics, it must be conceded that his researches have gone beyond the limits of private investigation and are invaluable aids to the scientific study of certain Indian Geological formations.

A PUZZLE.—The following from *Temple Bar* for December, once given by a Senior Wrangler at a dinner party, is far superior to most problems of this "Recreation" class:—"Supposing three snakes, each of which is swallowing another by the tail so that the three form a circle—then as the swallowing process continues the circle evidently grows smaller and smaller. Now if they thus continue to swallow each other, *what will eventually become of the snakes?*"

A MORAL AND A TALE.—In the early part of this century two natives discovered a reef of argenteriferous galena in the provinces about to be opened up by the Nagpur Railway. They promptly took specimens to the Raja of their territory, whose first question was: "Does anyone else know of the existence of this ore?" They assured him that no one else knew, and they were at once beheaded, the Raja remarking that if the *shahib logue* came to hear of the existence of this mine they would annex his country.

New Books and Reprints.

ART AND ARCHITECTURE.

DENYER (Alfred) Linear Perspective for the Use of Schools of Art. Hockliffe (Bedford) ... Pt. 2, 1/; Pts. 1 and 2, 1/

ROBINS (E. C.) The Temple of Solomon: A Review of the Various Theories respecting its Form and Style of Architecture. The Ethics of Art. Two Lectures. 8vo, sd., pp. 61. With 6 Plates. Whittaker 3/6

SCOTT (Leader). The Renaissance of Art in Italy. An Illustrated Sketch. New ed. 4to. Chapman and Hall ... 18/

STOKES (Margaret). Early Christian Art in Ireland. With 106 Woodcuts. (South Kensington Handbooks.) 8vo, pp. 210. Chapman and Hall ...

TIREBUCK (W.) Great Minds in Art. With an Introduction on and Artists. With Portraits. Post 8vo, pp. 340. Unwin ...

TUCKERMAN (Arthur Lyman) A Short History of Architecture. With Illusts. by the Author. Post 8vo, pp. 168. Bickers ... 6/

WRIGHT (Mark R.) Sound, Light and Heat. (Elementary Science Manuals.) Post 8vo, pp. 264. Longmans ... 2/6

CHEMISTRY AND PHYSICS.

ANTHONY (W. A.) and Brackett (C. F.) Elementary Text Book of Physics, 3rd ed., revised and enlarged. 8vo, pp. 527. New York 18/

CHARLES (J. C.) Elements of Physiological and Pathological Chemistry 8vo. Smith and Elder ... red., 12/6

CLASSEN (A.) Quantitative Chemical Analysis by Electrolysis, according to Original Methods. Authorised Translation from the Second Revised and Enlarged German Edition, by W. H. Herrick, A.M., Professor of Chemistry in the Pennsylvania State College. 8vo, pp. xi—178. New York ... 10/6

REYNOLDS (J. E.) Experimental Chemistry for Junior Students. Part 4. Chemistry of Carbon Compounds of Organic Chemistry. With an Appendix on Ultimate Organic Analysis. 18mo, pp. 360. Longmans ... 4/

STEELE (J. D.) A Popular Chemistry, 12mo, pp. xv—327. New York ... 6/6

STUTZER (A.) Nitrate of Soda: Its Importance as Manure. A Prize Essay. Re-written and edited by Paul Wagner. Cr. 8vo, sd., pp. 105. Whittaker ... 2/6

ELECTRICITY AND MAGNETISM.

BINET (A.) and Féré (C.) Animal Magnetism. (International Scientific Series.) Post 8vo, pp. 380. Paul, Trench and Co ... 5/

GORE (G.) Theory and Practice of Electro-Deposition, including every Known Mode of Depositing Metals, Preparing Metals for Immersion, Taking Moulds, and Rendering them Conducting. New ed. 12mo, pp. 130. Charles ... 2/

ENGINEERING AND MECHANICS.

ALL About our Railways. (All About Series, No. 1.) 12mo, sd., pp. 184. "Tit Bits" Office ... 1/

FIDDLER (T. C.) A Practical Treatise on Bridge Construction: Being a Textbook on the Design and Construction of Bridges in Iron and Steel, for the use of Students, Draughtsmen and Engineers. With numerous Illusts. and Lithographic Plates. 8vo, pp. 436. Griffin 30/

OXFORD and Cambridge Mechanics, Vol. 1., Statics. post 8vo. Gill 1/

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General Articles.

NEW OFFICES FOR THE MATHEMATICAL INSTRUMENT DEPARTMENT OF THE SURVEY OF INDIA.

THE illustration annexed is a third Elevation of the above Building, the other two, with description, having been furnished in our last issue.

We may add that the new Minister for Public Works went over these premises the other day, and the outcome has been that the block to accommodate the Photo-Litho. Branch of the Survey Department will be taken in hand sooner than was expected.

IRRIGATION IN BELUCHISTAN.

A SELECTION from the Records of the Government of India entitled the Zhara Karez Irrigation scheme, Beluchistan, has just been published.

As the Karez system of irrigation is confined to Beluchistan, Persia and the southern portion of Turkestan, it may be as well to give a description of it.

The "Karez" is simply a gallery or tunnel run into a hillside to tap the water bearing stratum. The tunnel must be run with some sort of upward slope so as to ensure a flow of water by gravitation. There are shafts to surface of ground at short intervals. In the Zhara scheme they are at 50 feet intervals. With shafts at such short intervals it is evident that it is the most economical plan for the Karez to follow the valley line, or what is the same thing, the bed of the torrent.

The old native Zhara Karez was about two miles long. It worked for 40 years, giving a discharge of about 9 cubic feet per second. When the Karez ran under the bed of the torrent the shafts were closed up. Occasionally some of these shafts are re-opened for clearing out the Karez. Two years ago some of the shafts through carelessness were left open and a flood coming down entered and choked up shafts and tunnels to an unknown distance. The owners of the Karez not being able to settle among themselves about the repair, the Government had to step in and do the work.

It was considered advisable to make a quite new Karez instead of patching up the old one whose alignment and levels were defective. The slope of the new Karez is 3 in 1,000, the slope of the valley being about 15 in 1,000. The section is 3' x 1'7", and judging from the old one, the discharge should be about 9 cubic feet per second. The estimate of cost is Rs. 11,500 for a length of 2 miles. The estimated rate for both shafting and tunneling is Re. 1 per 2½ feet run. The Karez will not only supply Killa Abdulla (a fortified post on the Kandahar road) with water, but also do a few hundred acres of irrigation in the valley of the Muchka Nalla.

In addition to the above, the official papers describe proposals for storage tanks for impounding the flood waters of the Muchka Nalla. There is nothing, however, special or peculiar in the tank scheme.

Nearly all travellers in Central Asia refer to the ingenuity of the Karez system, but it is probable that the Zhara Karez is the first that has been treated from an Engineering point of view. It would be interesting to know the methods employed in digging out the tunnel and removing the stuff through the shafts. What precautions are taken against the miners being buried alive? How the men manage to work in a cross section of only 3' x 1'7" etc. On these points the Reports are silent.

E. A. S.

NEARLY 600 acres of land are under sugarcane cultivation on the Rewa—the noblest river among the Fiji Islands—and here it is at Nansori, that the "Big Mill" of the Colonial Sugar Refining Company is situated. This mill is said to be the largest in the world, having a capacity of 20 tons of sugar a day, to obtain which it is necessary to crush on an average no less than 300 tons of cane.

FOREST PRESERVATION.

ELSEWHERE we reproduce some remarks by Mr. H. G. Turner, Agent to the Governor in Vizagapatam, on the water-supply of that district. It is possible that the printed statement may do less than justice to the report. It is also possible that the report may do less than justice to Mr. Turner's opinions. But taking the statements as they stand it appears that the Forest Department is charged with the entertainment of certain peculiar views regarding the sites of springs and the consequent necessity of preserving hillside forests. Hence we may profitably briefly indicate the rôle of a forest department.

A forest is a collection of trees, but it is something more. In an old forest we have overhead a leafy canopy. Underfoot we have various vegetable growths. This undergrowth is to the earth what the skin is to the human body. The trees rise from this skin like hairs from the body. The skin is composed of shrubs, mosses and grasses. Under this growth is a rich mould which represents the accumulation of centuries. We could sweep it away in a week. No skill could reproduce it in fifty years.

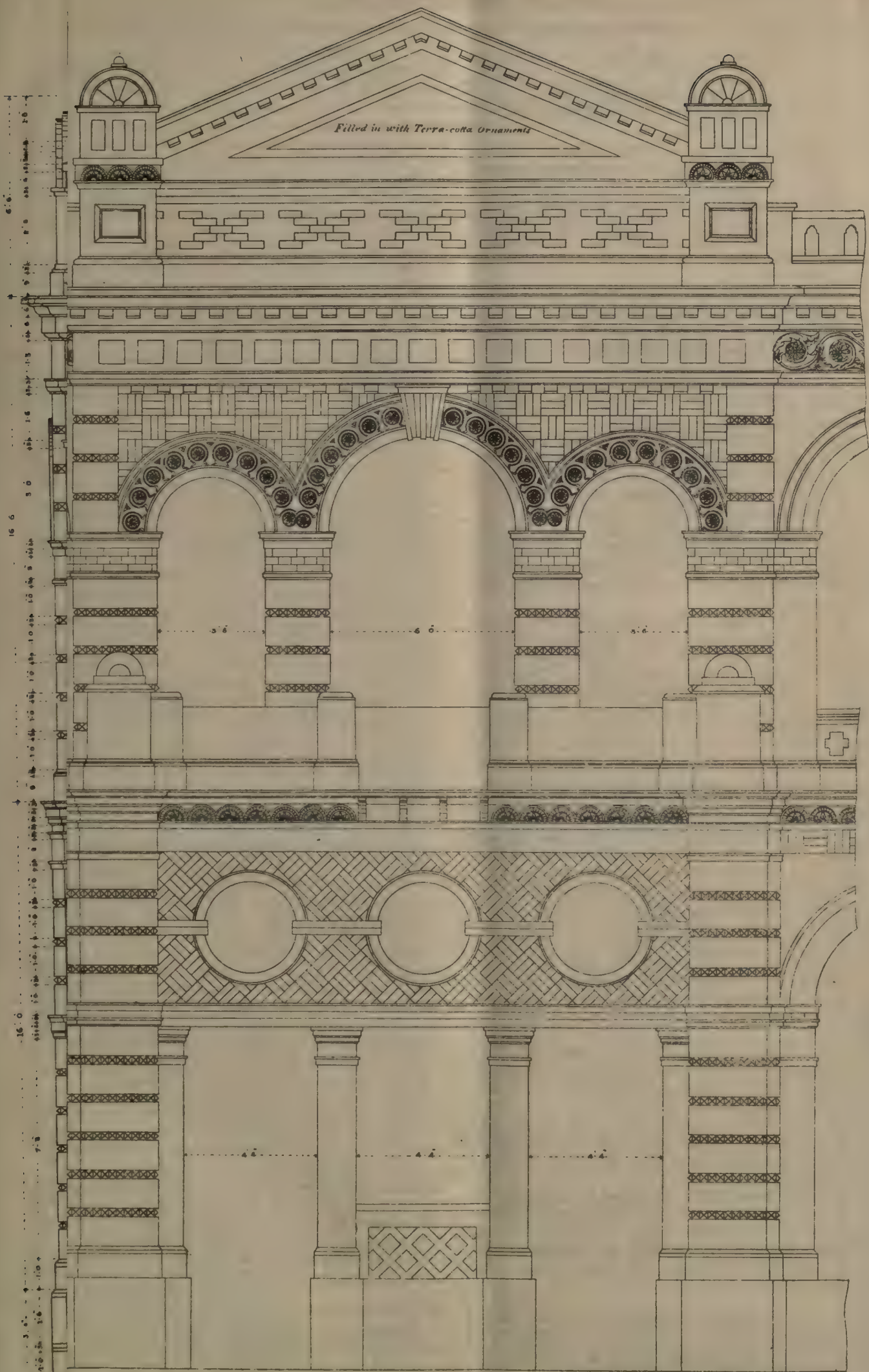
When we lay a seed in suitable soil by-and-bye there comes up a plant. When this plant has put forth leaves and has grown to its full size, from where has it obtained the material for its growth? Is it that the roots suck nourishment from the soil and send up all necessary material in the form of sap? By no means. A large proportion of the new material comes out of the skies. From the air is obtained a quantity of water and a quantity of carbon dioxide. This latter is the gas frequently called carbonic acid. The carbon dioxide is decomposed and the carbon is built up in the tissue of the plant. Liquid water is, so to say, solidified and forms another portion of the tissue.

After a time this plant dies and even while it was living its leaves may continually have died and fallen to the ground. When the plant is wholly dead its past history, so to say, lies around its former home. We are here supposing that the relics are not scattered by wind or by other agencies. The soil now may have more collectively in it and upon it than it had before the plant was sown there. Among these relics we may sow another seed. This in time will give a plant which does indeed to some extent find food in that mould of relics. But also it lays the air under contribution and is fed by the rain that falls there, or the vapour that comes with the air. When this second plant has wholly died, its relics are added to that portion of the former relics which was not by the second plant absorbed and built afresh into tissue. After many generations of plants have lived and died on that spot of ground, it holds the tribute received from cubic miles of air through long spaces of time. Such is the history of the soil over which we tread as we wander through an ancient forest. There is old age in the massive trunks, but there is old age likewise in the soil that sustains them.

In similar way, on a coral island in the Pacific there is at first a tiny accidental growth of vegetation. By-and-bye this is multiplied, till we find a fertile island fit for the abode of man. Thus also in the desert of Sahara let us bring water to the surface by means of an artesian well. By-and-bye we have grasses and a row of date palms. These date trees are not transmuted sand, they came from the winds of heaven.

Let us suppose ourselves to do what savages or thoughtless pioneers have done, in many lands—let us visit an old forest and cut its patriarchs down. Now let a heavy rain descend on that mould of ages. It is carried down to rivers or scattered far and wide over lower lands. That mould was potential wealth—that wealth exists no longer.

On the other hand, let rain equally sudden and equally violent descend on an old forest. Much will have fallen before the ground below has become appreciably wet. After the leaves have received as much as they can hold, the soil will begin to get droppings. The water thus gently falling from the height of the lowest leaves will not disturb the arrangement of the mould. This mould will act



like a dry sponge absorbing and accumulating in its interstices a great mass of water. This mould in turn holds up the water so that for a time nothing finds its way to the lower lying strata. Frequently all the water that has fallen will be lodged and retained in the mould. There it can remain a considerable time, as the evaporation will be slight. Meanwhile, the grasses, shrubs and the great trees will be feeding on this water. Thus the mould acts as a treasure house or reservoir. But if such a heavy shower were to fall on open land most of the rain may run off before the vegetation has had time to make proper use of it, and, in so running off, it is not only useless, but injurious, as it carries good soil along with it. Especially is this likely to happen if the open land is on a hillside.

In a country like India we may have months of dry weather, and then the rain comes down as if all "the waters that are above the firmament" had decided to stop there no longer. If these waters, which are above the firmament, could be arranged in the manner of a shower-bath—ourselves to pull the string when so it pleased us—then forests anywhere, and especially in countries like India, would lose one of their recommendations. Here we have only been thinking of forests as modifiers, distributors or reservoirs of moisture. In some of the States of North America the early English settlers cleared off the forests with such thoughtlessness, that now for the manifold wants of their thriving communities they have to import timber all the way from Canada. Probably these are some of the truths that the Forest Department are preaching in Vizagapatam.

Let us now consider the question of the site of a spring. At one of the highest points of the Brocken, which is the topmost peak in the Hartz Mountains, there gushes out a spring called the "Sorcerer's Spring." It is so called because its appearance there suggests some sort of magic. The wonder is where the water comes from to supply its unceasing flow. The explanation is that the mountain is crowned by a plateau. The highest point of this plateau is about twenty feet above the spring. When the extent of this plateau is considered and the quantity of rain that falls on it is calculated, it is found that the rainfall is more than sufficient to supply the outflow of the spring.

This spring is exceptional in its position, but it is mentioned here as a caution against the dogma that springs never rise out of hillsides.

Let us for the general case consider rain falling over a large extent of mainly open country. All that the vegetation and topmost soil does not at once absorb sinks to lower strata. As long as these are easily permeable the water continues under the action of gravity to work towards the centre of the earth. At last the water reaches some water-tight stratum, and then its course must change. This stratum will not be a perfectly level plane, but it will have crumples or folds—though these may be only slight—and will in some direction slope downwards. Along this downward slope—which again may be slight—the water will run. As it runs it will chiefly collect in the folds or channels, and these channels will run into each other. Thus we have a subterranean system of streams, all running it may be finally into one main stream. If this impervious stratum somewhere strikes the surface of the earth, then at that place—called the outcrop of the stratum—the water will gush forth and we give it the name of a spring.

The water in its course to the spring may have ups and downs. All that is necessary is that the spring itself shall be at a lower level than some other parts of that water-tight or impervious stratum. Whether this outcrop of the stratum happens on a hillside or happens in a valley between two hills is—so to say—an accident.

Let us for a moment imagine that the spring rises out of a hillside and let there be a small forest round the spring. Then the outflow of that spring is only slightly influenced in any way by that forest, for the spring may drain a thousand square miles of the earth's surface while the forest may be less than ten square miles in extent. If a forest department took to protecting that forest it would not

be with the chief object of preserving undiminished the outflow of that spring.

As another case, let us suppose a couple of long hill ranges with a valley or system of valleys between them. Let us imagine that the water-tight stratum crosses these hills passing under the valleys—not striking anywhere in the neighbourhood the surface of the earth. Then the rain that falls and sinks into the ground on those hillsides which face the system of valleys will tend to run into the valleys. The water thus forms a curved sheet following the indentations of the water-tight stratum. In the valleys the upward pressure of this water thus resting on the impervious stratum becomes great, as it has what engineers call a head of water. Suppose that somewhere in one of the valleys the ground above the water-tight stratum is easily penetrable by the water. Then the water will well up there, and though it may begin with a small opening, it will gradually enlarge it by the mere mechanical action of the water. In this case we have the spring site in a valley. The lower the site where the water finds its way back to the earth's surface the more abundant the flow is likely to be, because the extent of earth surface thus drained is likely to be larger. Such a spring is also likely to be more constant in its flow, for though there may be dry weather over one part of the thus drained earth surface, heavy rain may be falling elsewhere, and so keeping up the average.

Lastly, suppose that in the valleys between these hill ranges there is no one small spot of earth below which the ground over the water-tight stratum offers an exceptional facility to the upflow of water. But let there be a somewhat considerable extent below which the soil or the rocks are all equally and moderately pervious. Then the water will tend to escape upwards through this extent of ground and we have perhaps a lake formed. If the outflow of water is less considerable, or the evaporation is great, we may only have a marsh or swamp. In this latter case there is no reason why the ground should be nearly level.

If, however, the forest is comparable in extent with the country drained by the spring then the value of the forest in sustaining and equalizing the flow of the spring has been proved beyond all question. Especially is this the case when the land is on a slope.

As regards the statement that a "hillside is about the worst receptacle for the retention of water that can be imagined," it may be sufficient to mention that on the peaty mountain slopes of Ireland and Scotland there are lodged at the present moment some millions of tons of water.

THE WATER-SUPPLY OF A COUNTRY.

MR. H. G. TURNER, Agent to the Governor in Vizagapatam, in his remarks on the water-supply of the Vizagapatam district, in his report on the administration of the agency tracts during the year 1886-87, writes:—It is a remarkable fact that there is so much misapprehension on the subject of the rise of rivers. Over and again it is stated that brooks rise on the sides of the hills. This was, and possibly still is, one of the many dogmas of the Forest Department, who perpetually implore Government and harangue the public on the folly of cutting down trees on the side of hills because the water-supply of the country is thereby imperilled. Now the sources of rivers are not to be found on the sides of hills. Springs do not gush out of the hillside, like in the picture in the Family Bible which shows a fountain of water springing forth from the rock at the touch of Moses' rod. There is not in the hot weather a single spring of useful dimensions, issuing from any hillside, in Southern India. Nor is there a congeries of such springs whose united flow forms the head of any river south of the snow-fed rivers of the Himalayas. The sources of all rivers in Southern India are on plateaux and in long sloping valleys and swamps; and river water is the gradual off-flow of the rainfall of the country. If all the plateaux and all the valleys in Southern India were tilted up at an angle of 45 degrees, there would not be a single perennial river in the Madras Presidency. To imagine that rivers rise on the sides of hills is equivalent to a declaration that the sloping roof of a house forms an admirable reservoir. The truth is that a hillside covered or uncovered with forest is about the worst receptacle for the retention of water that can be imagined. If the forest be cut down and the earth turned up for cultivation, water may penetrate, and doubtless does reappear in the form of springs further down. But all this source of supply is exhausted long before the hot weather sets in, and perhaps in February, certainly in March, miles and miles of forest may be traversed without seeing a trickle issuing from the hillside. This statement is sure to be contested, but I am prepared to illustrate the truth of my assertion by reference to the head waters of the Saveri,

Sileru, Cauvery and Periar, with all of which I have some actual acquaintance. I may say that years ago when I ventured on these views in the presence of Dr. Brandis, he was so struck with their importance, that he proposed to form a committee to test their truth. Nothing was done, however, and people still go on repeating the same old saws, about springs gushing out of hillsides and of the necessity of preserving the jungle in order to protect water-supply. From that time to this I have never failed to take note of these phenomena, when I have been in the jungle, and everything I have seen confirms me in the accuracy of the observation. I mention this matter here for two reasons: one is that I impress my views on every forest officer I come across, and I trust that I am gradually disseminating a propaganda of disbelief in the older tenets of that department; and secondly because I want to prevent this reason of protecting water-supply from being brought forward to justify restriction in the matter of the hillman's hillside cultivation.

IRRIGATION IN EGYPT.

[Translated from the "*Annales Industrielles*"
expressly for INDIAN ENGINEERING.]

M. BAVOIS, *Ingénieur au chef des Ponts et Chaussées*, Secretary-General to the Minister of Public Works in Egypt, has just published in the Bulletin of the Department of Hydraulic Agriculture a complete study of the actual state of irrigation in Egypt. It is impossible for us to do more than to take up a portion of this very comprehensive work, and we shall confine ourselves to the description of the most important irrigation works in Lower Egypt. First of all, it will be useful to notice that the Valley of the Nile, situated between the first cataract at Assouan up to a few miles north of Cairo, has the shape of a long and narrow strip of land. The maximum width of this valley scarcely exceeds anywhere 15 miles, and averages only 7 to 9. The area of this part of Egypt, designated under the name of Upper Egypt, is about $2\frac{1}{2}$ million acres.

The Delta, or Lower Egypt, commences a little distance to the north of Cairo, and comprises the Delta proper, that is the country lying between the two branches, the Rosetta branch to the west, and the Damietta branch to the east, in which the Nile bifurcates a short distance below Cairo, and also the cultivable strips of country lying outside these two branches. The superficial area of Lower Egypt is about 3,150,000 acres. The total population of the Valley of the Nile from Assouan to the sea is, according to the census of 1882, 6,302,000.

In Upper Egypt irrigation is effected by the total submersion of a series of basins formed by embankment running parallel with, and transverse to, the course of the river. These basins are filled according to their position, either by canals direct from the Nile or else by means of masonry works. The water is drawn from one basin into another. This system, which has been used from time immemorial, does not permit the utilisation of the soil, except during a portion of the year, and the cultivation is confined to cereals.

On the other hand, in Lower Egypt improved processes are employed whereby very productive cultivation is rendered practicable.

Before mentioning the great canals which water this region we must say a few words regarding the barrage or weir established at the point of the Delta. This work, undertaken in 1843 by Mongel Bey, is still incomplete. It is constructed at the exact spot where the Rosetta and Damietta branches take off, and is in reality composed of two barrages, one over each branch connected by a tongue of earth about 3,000 feet wide, which forms the extremity of the Delta. This, enclosed by a circular quay, is cut in the centre by the great Menoufieh Canal, destined for the irrigation of the lands lying between the two branches of the Nile and which takes its supply from the water upheld by the barrages. The barrage over the Rosetta branch is formed of 61 arches of 5 metres span with piers of a thickness of 2 metres. At each end is a lock—one of 12 and one of 15 metres width. The total length of this work is 465 metres. The barrage over the Damietta branch is identical in design with the preceding, excepting that it has 10 more openings. Its length is 545 metres. According to the original design the level of the water above the barrage should be able to be raised to 4.50 metres above the low water level, which was supposed to

be 11.80 metres above the sea level. The upstream reach should therefore stand at 16.30 metres above the sea level.

It was, however, discovered that the normal level below the barrage would not stand at a higher level than 10 metres above sea level, consequently the barrage would have to hold up a depth of 5.80 metres to obtain the high level originally sought.

The foundations were formed of a layer of beton covered by a brick flooring with courses of ashlar. The total width of the floor is 34 metres with a thickness of 3.50 metres, with up and down stream curtains 5 metres in depth. The flooring is prolonged on the down stream side by an apron 8 metres wide formed by a foundation of loose stone of a mean thickness of $1\frac{1}{2}$ metres, covered by a bed of beton. This apron is terminated by a solid wall of beton 4 metres wide and 3 thick. The total combined width of floor and apron is thus 46 metres. In the Damietta branch, and in the greater portion of the Rosetta also, the floor is founded on clay. (To be continued.)

MAIL STEAMERS AND THEIR SPEEDS.

By A. EWBANK.

III.

As this discussion, which has the mail steamer for its text, is addressed to the non-professional and non-mathematical public, we may usefully introduce the consideration of the marine engine, by looking first at the more familiar railway locomotive. And this, again, may be prefaced with a few remarks upon steam.

Let us have in a metallic vessel a sufficiently large supply of water, which does not entirely fill the vessel. Let the vessel be closed, except that a narrow passage—say one inch or less in diameter and six inches in length—conducts to the outside air. Let the water be heated by a furnace under the vessel. In course of time the water will boil, and thereafter a jet of steam will steadily issue from the orifice of the narrow passage.

If we could hang a thermometer inside the vessel, but above the water, it would register approximately 100° on the French or centigrade scale. If we quicken the fire by suitable means, we increase the production of steam. But the temperature of steam inside the vessel is not appreciably altered. The jet of steam would indeed be stronger, and we assume that the passage is large enough to allow in each second as much steam to escape as is in that second produced.

The size of the passage must thus be in same relation to the quantity of water and to the vigour of the furnace. If the passage does not carry off steam at the same rate as it is produced, the conditions are greatly altered. The thermometer suspended inside will now shew a rise of temperature.

The steam in the vessel will become denser than before; i.e., a cubic foot of steam will now weigh more than it did when the temperature was 100° C.

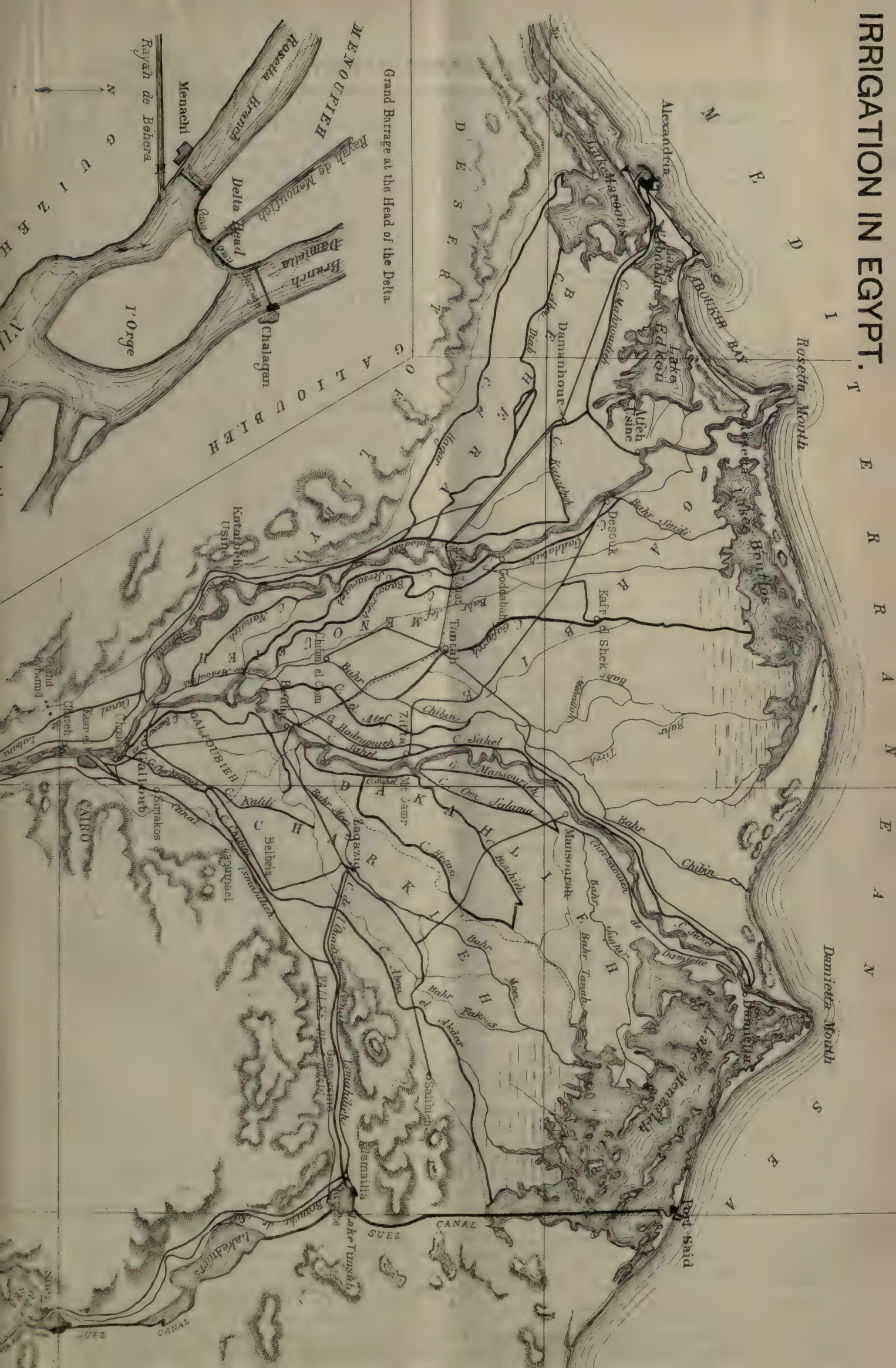
If after the steam has thus become denser than it was at 100° C we imagine the furnace suddenly removed, the generation of fresh steam will soon, though not instantaneously, cease.

The jet of steam, on the other hand, will not cease merely because the generation of fresh steam has ceased. Some of the steam filling the vessel will continue to supply the jet. The jet will only cease when what is called the pressure of the inside steam has become reduced to the pressure of the outside air.

When the jet has ceased let us imagine a rupee or any other disc to be laid on the mouth of the passage. On the outside surface of the disc there is atmospheric pressure. On the under or inside surface there is steam pressure. These pressures are equal. The steam is then said to be at one atmosphere or of one atmosphere. The expression "at one atmosphere" means at the pressure of the atmosphere.

Originally when the thermometer marked 100° C, if we at any moment stopped the production of fresh steam the jet would at once cease. The steam inside would then be at atmospheric pressure. These results are given

IRRIGATION IN EGYPT.



here merely as obtained from experiment. The reader is not supposed to busy himself with inquiring into the why and wherefore. Experimentally we find that steam at 100°C is the same as steam at one atmosphere as regards its pressure. The steam is here produced from water, and it remains in the presence of other water, which has not yet been converted into steam. Steam thus existing in the presence of water—in contact as we say with water—is said to be saturated. If we isolate some of this saturated steam, *i.e.*, if we put it into a closed vessel, which contains no liquid water, we may proceed to heat the imprisoned steam to some higher temperature. Then the steam becomes what is called superheated steam. Occasionally engineers call it dry steam. Some engines use saturated steam, others use superheated or dry steam.

The vessel in which we produced the steam must originally have contained air. But as the saturated steam was incessantly produced, it gradually drove the air out of the vessel, and we are supposed to be dealing with a subsequent time, when all the space in the vessel that is not occupied by water is occupied only by saturated steam.

The ordinary locomotive produces in its boiler saturated steam. This is then conducted to the cylinder, where it drives a piston. After the piston has nearly traversed the whole length of the cylinder in one direction, the steam that has thus driven it must be removed. A passage is accordingly opened for it into the outer air. Fresh steam is simultaneously admitted from the boiler into the cylinder, but at the other side of the piston, and this fresh steam drives the piston on its return journey.

We thus see that for the piston to perform its movements to and fro with as much ease as possible, that former supply of steam whose work has been accomplished in driving the piston one way, should promptly disappear from the cylinder. Otherwise it must embarrass the piston on its return journey by offering a counter-pressure to the pressure of the last supply of steam admitted into the cylinder.

Whether a locomotive is an economical worker, *i.e.*, whether it turns into work a large percentage of the heating power derived from coal, is a question important chiefly in what we may call the commercial or financial aspects. As a matter of fact a locomotive engine is a wasteful machine for producing power. But in the construction of a locomotive, economy of coal expenditure is by no means the chief consideration. Coal and water are easily stored up at points along the route. Or instead of recoaling, a fresh engine—with its tender—may be put on—an arrangement not possible for the mail steamer.

The first requirement in the locomotive is strength and simplicity of structure. It must be able to bear jolting without a breakage and without the mechanism being disturbed in its action. Then the machine must not be too bulky. Two engines have to pass each other on a narrow strip of land. Land being expensive to buy, and being valuable for other uses, besides railways, it is desirable to have the long strip of land not unnecessarily wide. The wider the engines the stronger must be the material and the more likely we are to have breakdowns. The wider the engines the greater the air resistance and therefore the greater the difficulty in maintaining high speeds. The wider the engines the broader must be the tunnels excavated out of solid rock and the bridges that are thrown over rivers.

If now we have our engine already made, and it is so constructed as to satisfy the conditions of non bulkiness—proper strength—simplicity of mechanism for the ordinary engine driver to understand, or control, and such other important desiderata—we may then proceed to inquire into its efficiency in extracting power from the coal it carries on its tender. This question is in fact a double question. There is first a certain limitation to its theoretical efficiency. This limitation is supplied by the nature of heat. The knowledge of the limitation is supplied by the modern science of heat. There is secondly the question how nearly the engine approaches that limit which it cannot in any way surpass.

Let us suppose that the boiler is made to provide steam of 170°C . This means a pressure of about 8 atmospheres. The pressure of saturated steam increases more rapidly than does its temperature. Let the steam when about to escape into the outer air have a temperature of 120°C . This means a pressure of about 2 atmospheres. These results are furnished by experiment. In this case, *i.e.*, with these pre-assigned temperatures chosen by the designer of the engine, the engine cannot possibly transform into work more than a certain fraction x of its total coal energy. Approximately x may be put at $\frac{5}{14}$, and more roughly at $\frac{5}{14}$, which is less than $\frac{1}{3}$ th. The engine constructor will certainly fail to attain this ideal result. He will perhaps, however, get more than half of it. Suppose he succeeds in constructing an engine which transforms into work $\frac{1}{2}$ th of the energy in the coal that is burned in the furnace. Fairly to judge of the excellence of this engine we should not fix our attention on the fraction $\frac{1}{2}$ th. It would be more just to compare the actual result indicated by $\frac{1}{2}$ th with the ideal result which latter is expressed by a certain fraction less than $\frac{1}{3}$ th. We shall then conclude that the engineer has effected upwards of $\frac{2}{3}$ ths of what was theoretically possible.

(To be continued.)

KURRACHEE HARBOUR WORKS.

III.

THE amount of expenditure includes £12,000 for rectification of the entrance channel (especially the inner end), at the rate of about £4,000 per annum for the last three years, since it was fully formed. This expenditure will be reduced with the help of the new dredging plant now under provision; but, to bring it to a minimum, some further works of no great cost are desirable, which will be referred to presently.

It now only remains to mention what further works were proposed.

These include dredging in the entrance, in the lower harbour, especially along its east channel, and here and there in the new channel of the upper harbour, so as in all to guide the operation of scour, and to aid it especially by the removal of hard material, *i. e.* shingle and sandstone.

Also, to aid the scour, it is proposed to reduce the width of the lower harbour by "groyning" the west side, a work now in progress, as supplementary to the dredging, to accelerate the deepening, which has for some years been steadily in progress, in the east channel of the lower harbour.

It was intended that the above works, and such further dredging as might be required here and there, to increase the berths for shipping, would be met from the sanction of one lakh of rupees per annum for dredging, including cost of establishment, which was granted by the Government of India, in 1877, to be expended on dredging for the following ten years, or for such other period as future experience may suggest.

At the same time sanction was given to the provision of new dredging plant. For this valuable sanction of dredging and plant, Kurrachee owes a large debt to the advice and influence of Sir Andrew Clarke, Minister of Public Works in India.

The additional works proposed, were, an extension of the east pier (groyne) on a curve for a length of 1,100 feet, for prevention of eddies and shoaling in the entrance channel and anchorage, from cross rush of flood, also for extension of anchorage space for 2 or 3 large vessels. Also the reduction of the rocky projection on west side of lower harbour, called "Deep Water Point," so as to lead ebb scour into entrance channel, and to improve anchorage by quieting tidal rush and eddies, and by filling in the deep rocky gut opposite, so as to give berths for 2 or 3 large vessels.

Further, two important works of accommodation were proposed, the first of which is an iron screw pile-pier at Keamari, fitted with complete appliances in the way of hydraulic cranes, and by means of which one of the

largest and two medium sized vessels could discharge or load rapidly, in direct connection with the Indus Valley railway system.

This work was proposed by Mr. W. H. Price, M.I.C.E., as part of the harbour improvements, as there was no doubt that it would prove profitable, giving greatly needed facilities for transport of troops and stores, as well as for direct up-country traffic in goods and railway materials.

The second work of accommodation is a graving dock, for reception of the largest steamers, a requirement which needs but little remark, seeing that the port was quite unprovided with any dock or other appliance for examining or repairing vessels.

The additional works proposed, including the portion of them which had been sanctioned, was estimated to cost a total of £273,858.

Adding this to what has been already expended, makes a total of £764,798 for the improvement of the harbour, so as to fairly carry out the object contemplated by Mr. Walker, at a cost of £660,000 namely "to make Kurrachee suitable for an extensive trade in shipping of large tonnage."

(To be continued.)

PRINCIPLES OF MECHANICS.

BY A. EWBANK.

VII.

In the preceding papers appeals have occasionally been made to the reader's mechanical sense, instinct or insight. Mechanical science is really a natural science. We deal with forces as they act in nature and our final appeal in all cases of doubt is to the verdict of experience when experience is properly, *i.e.*, fully interpreted. Thus we have expected the student to allow that if two equal forces act on a small body and act at a certain angle, the small body will tend to move in no direction but one, and that that direction bisects the angle between the original forces. We also expect the student to believe that if two forces, each 6lbs., act on a body at a very small angle the resultant is less than 12lbs., but is nearly equal to 12lbs.

Now, such a conclusion in the mind of the student we may possibly consider derivable from experience. A man cannot in a dark room work out for himself what would be the behaviour of a lump of sugar if placed in a tumbler of water. It is experience that teaches him to expect the sugar to dissolve, but to expect a lump of quartz, if placed in water, to remain unchanged. If a man had never had any occasion to see two forces combining their effects, but yet had from experience a vivid idea of the action of one force in compelling motion, he might conceivably—if asked how forces would combine—proceed to reason as follows: "One day I saw a man drink some wine and it produced an exhilarating effect. The next day he took an equal quantity and it acted as before. The third day he took a double quantity, but instead of producing a double exhilaration, it produced stupefaction. Thus the resultant of two equal forces which act together may be quite different from the simple effects superadded."

The exact amount of our knowledge which should be described as innate, and the exact amount which is purely attributable to experience, is a disputed question among what are called philosophers. So also is the exact meaning to be given to innate. Does it mean the accumulated—the absorbed—experience of our human ancestors collectively up to date, or does it mean the knowledge or power of reasoning which the first of these ancestors possessed, and which his descendants have since individually possessed, not because they were his descendants, but merely because they were ordinary human beings. In other words, is instinct a progressive ability, or is it a stereotyped quality? But we will not here spend our time on these questions. Therefore, we merely say that in a natural science we appeal to the student's instinct or to his experience or to both.

We found that to enable us accurately to determine the resultant of two equal forces at right angles, we needed to obtain the value of $\sqrt{2}$. Any method which Arithmetic or Algebra can supply for doing this work we may use in our mechanics. To us Arithmetic or Algebra are like the file or chisel which the carpenter may use in making a box or a table.

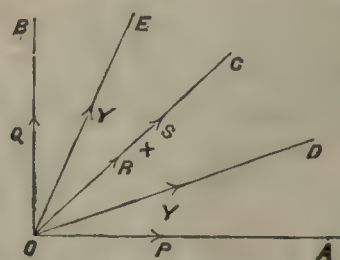
The chisel is a tool or instrument in the hands of a carpenter. Algebra is an instrument in our hands. We may possibly benefit by other instruments. But we use them to a mechanical end. Our reasoning throughout is purely mechanical, though the language in which we reason may be made more compact by symbols derived from this or that branch of mathematics.

Thus we proceed presently to make use of the word "Cosine," which itself is purely a geometrical term. But whatever aid we accept from geometry or trigonometry we will explain at the time, and will explain it in such a way that the student who has never before heard of a Cosine—or such other symbol as we may borrow—may be in no way prevented from following and appreciating this exposition of the principles of mechanics. Following out the analogy above suggested, we will act as a carpenter who makes his own tools while he is making a table.

Before introducing the term Cosine we will return to our method for deducing resultants and will make a slight modification in the expression of our final result. Let two forces each 1lbs. act at an angle. Then they produce a resultant which is less than 2P, and we will call the resultant $2Px$. For example, if P is 5lbs. and the angle 90° , we have $2Px$ or $10x=7$ nearly. Here $x=\frac{7}{10}$ nearly.

Let us imagine two forces of 5lbs. each acting at some angle which is nearly a right angle (more or less) and producing a resultant exactly equal to 7lbs. Then for this case $2Px=7$ and $x=\frac{7}{10}$ exactly. By the nature of the case x is always a proper fraction. It may in the limit become 1 if the angle between the forces vanishes. And it may in the limit become zero if the angle between the forces becomes 180° , *i.e.*, if the two forces are directly opposed. Failing these extreme cases we say x is always a positive proper fraction. Algebra may introduce negative quantities, but we in our mechanics are now only dealing with positive quantities.

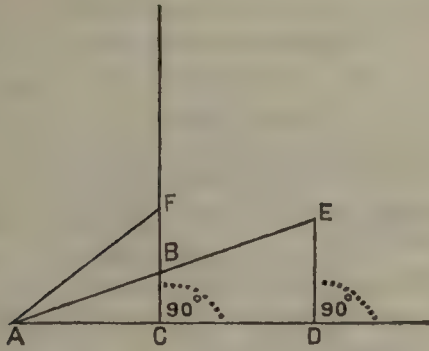
Fig. 11.



Let P and Q be two equal forces as in fig. 11. Then the resultant is $2Px$ along the bisecting line OC. If $R=S=P$ we may say that the final resultant of P, Q, R and S is along OC and is $2P+2Px$. But we may combine P with R and obtain a force $2Py$ along OD. Similarly, Q and S give $2Py$ along OE. As P and P give $2Py$ it follows that $2Py$ and $2Py$ give $2y \times 2Py$ along OC. $\therefore 4Py^2 = 2P + 2Px$. $\therefore 1+x=2y^2$. Here x and y are both proper fractions and this formula enables us to find one if we already know the other. Also x or y is merely a number such as $\frac{3}{4}$ or $\frac{2}{3}$. For instance, x is merely the fraction which the force denoted by $2Px$ is of the force denoted by $2P$.

Now the formula or equation $1+x=2y^2$ occurs also in trigonometry where x and y are also mere proper fractions. And the value of x and y being obtained by trigonometrical means may be used in our mechanical reasonings because x and y themselves are not forces or lines or angles or anything but mere numbers. These numbers x , y also occur in optical questions and in questions of magnetism, and in fact in all physical sciences.

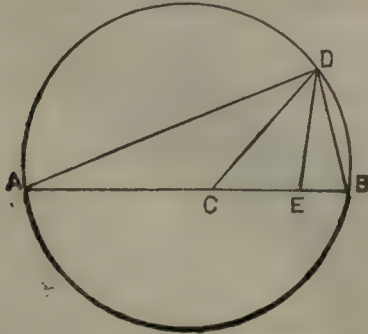
Fig. 24.



In fig. 24 ACB is a right angled triangle. AB is the largest side, generally called the hypotenuse; and AC when viewed with reference to the angle A, is called the "side adjacent." Then the fraction $\frac{\text{side adjacent}}{\text{hypotenuse}}$ or the proper fraction which gives the ratio of the smaller side AC to the larger side AB, is called the *Cosine* of the angle A, and for shortness is written Cos A . If we choose to consider A as being an angle in the larger triangle AED, then Cos A means $\frac{AD}{AE}$. But this is the same in value as $\frac{AC}{AB}$. Thus the value of the Cosine is no way dependent on the size of the triangle from which it is obtained. It depends only on the angle A itself. If this angle be increased—if for instance we take the angle CAF—the new Cosine is $\frac{CA}{AF}$, and this arithmetical proper fraction is less than $\frac{AC}{AB}$.

Thus as an angle increases its Cosine diminishes. If the angle CAF increase by F continually moving along the line CB produced, we ultimately have CAF approaching a right angle, and the Cosine approaches the value zero. If B move so as to approach C, the angle called A decreases towards zero, and the Cosine increases so as to approach the value unity. Thus the limits of the fraction called a Cosine are the same limits as we established for x , when we said that P and P give a resultant $2Px$. And whatever be the value of x as used in our mechanical reasoning, we can always construct some angle BAC such that $\frac{AC}{AB} = x$, or that the line AC is x times the line AB where x is really a proper fraction.

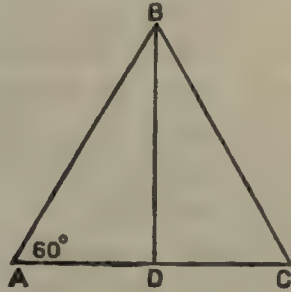
Fig. 25.



In fig. 25 we have an acute angle ECD, and another acute angle EAD. C is the centre of a circle, ACB is a diameter, and we learn from geometry that $\text{ECD} = 2\text{EAD}$. Let us consider the Cosine of the angle EAD, and also the Cosine of the double angle ECD. $\text{Cos ECD} = \frac{EC}{CD}$ by definition of a Cosine where

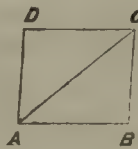
E is 90° . $1 + \text{Cos ECD} = 1 + \frac{EC}{CD} = \frac{CD + CE}{CD} = \frac{CA + CE}{CD} = \frac{AE}{CD}$. $\therefore \frac{1 + \text{Cos ECD}}{2} = \frac{AE}{2CD} = \frac{AE}{AB}$. $= \frac{AE}{AD} \times \frac{AD}{AB}$. Now the angle ADB is a right angle and the triangles AED, ADB are similar, i.e., they have their sides proportional. Thus $\frac{AD}{AB} = \frac{AE}{AD}$. $\therefore \frac{1 + \text{Cos ECD}}{2} = \frac{AE}{AD}$. $\times \frac{AE}{AD} = \left(\frac{AE}{AD}\right)^2$ and $\frac{AE}{AD}$ is the Cosine of EAD. $\therefore 1 + \text{Cos ECD} = 2 (\text{Cosine EAD})^2 = 2 \text{Cos}^2 \text{EAD}$ as it is usually written for shortness. Now for the Cosine ECD put the quantity x . For Cos EAD put the quantity y . Then our trigonometrical or geometrical result may be written $1 + x = 2y^2$. But this is exactly the relation we obtained between two quantities x, y which we introduced with mechanical meanings. Our mechanical conclusion was that if P and P at some angle α give a resultant $2Px$ then P and P at the angle $\frac{\alpha}{2}$ must give a resultant $2Py$. But x can, as we have seen, be called the Cosine of some angle β . And we now see that y must then become the Cosine of $\frac{\beta}{2}$. So we may say that if P and P at an angle α give a resultant $2P \text{Cos } \beta$, then P and P at $\frac{\alpha}{2}$ must give a resultant $2P \text{Cos } \frac{\beta}{2}$. The values of $\text{Cos } \beta$ as β changes from zero to 90° are registered in "Mathematical Tables."

Fig. 26.



In fig. 26 we have an equilateral triangle bisected by the line BD. Then $\text{Cos A} = \frac{AD}{AB} = \frac{1}{2}$ or $\text{Cos } 60^\circ = \frac{1}{2}$. Now we know that P and P at 120° give a resultant $= P = 2P \times \frac{1}{2} = 2P \text{Cos } 60^\circ$. Here then $\alpha = 120^\circ$ and $\beta = 60^\circ$. Therefore by what precedes we can infer that P and P at half of 120° give a resultant equal to $2P \text{Cos } \frac{60^\circ}{2}$ or P and P at 60° give $2P \text{Cos } 30^\circ$. Thus again it follows, by the same rule, that P and P at 30° give $2P \text{Cos } 15^\circ$ and so on. Hence for the series of angles $60^\circ, 30^\circ, 15^\circ$ &c., we can say that the resultant is twice one force multiplied by the Cosine of half the angle between the forces.

Fig. 12.



Again in fig. 12 we have a square bisected by AC and Cos BAC or $\text{Cos } 45^\circ = \frac{AB}{AC} = \frac{1}{\sqrt{2}}$. But we know that P and P at 90° give $P \sqrt{2} = 2P \times \frac{1}{\sqrt{2}} = 2P \text{Cos } 45^\circ$.

Therefore here $\alpha = 90^\circ$ and $\beta = 45^\circ$. Therefore as above we inter that P and P at 45° give $2P \cos 22\frac{1}{2}^\circ$ and that P and P at $22\frac{1}{2}^\circ$ give $2P \cos 11\frac{1}{4}^\circ$ and so on. Thus also for the series of angles 90° , 45° , $22\frac{1}{2}^\circ$, &c., the resultant is twice a component multiplied by the Cosine of half the angle between the components. We may write this result briefly thus: $(P, P, \alpha^\circ) = 2P \cos \frac{\alpha^\circ}{2}$.

(To be continued.)

NOTES FROM THE TENASSERIM.

THE holidays are over. Christmas has come and gone, and with it all our visitors. The Volunteer Camp of Exercise at Toungwine has been admitted to be a success by all. Inclusive of cadets about five hundred Volunteers attended the camp. The Maulmain Corps, however, was conspicuous by its paucity, and this is due no doubt to the camp being held very near Maulmain, the members preferring their warm beds at home to a shake down in tents; but after all, the men cannot be blamed for their non-attendance. It is rather hard lines on them to sacrifice their very few holidays to serve, indirectly perhaps, the purpose of Government. As our local *Times* puts it.—“Hold the camp during any other time of the year, except other holidays, and see if the turn-out will not be all that can be desired. Volunteer corps are largely recruited, in fact almost wholly composed, of the middle class, who could ill afford to spend their leisure in further serving Government, indirectly though it may be,” &c. I quite agree with the *Times*, and doubtless many others will too, if they choose to read the issue of the 6th January 1888.

I regret to state that cholera is still prevalent in the jail, while there have been but few cases outside. I hear the site of the jail has been condemned, and a committee about to sit to select another. It is time they did.

The Editor of the *Maulmain Times* has got himself into trouble and the paper is now advertising for a new Editor.

Our Cathedral has not progressed one whit since my last. The entrance road and culverts, however, are completed.

The public are complaining of the dust in Maulmain and certainly it is a just complaint. The roads are metalled with stone procured from Bombay, I hear, but I can hardly believe that the Municipality would have gone to such expense when stone as good as that now on the roads is procurable in the district itself. I picked up a piece of this stone one day, and found it to be nice and hard, and could scarcely believe that the fine blue powder on the road before me was but this stone in its second stage of existence. That a stone so hard and compact could be so easily pulverized was scarcely credible, but “facts are stubborn things.”

No progress on the Victoria Park. The Municipality lately put up to auction some land in Salween Park at upset prices, but none came forward to bid, the upset prices being rather too high, perhaps.

We have had a fire since my last, and I really believe it has done the town good, for it has cleared away one of the unhealthy parts of the town. The houses to be erected on it will, of course, be subject to Municipal regulations, and we may therefore expect to see a transformation in that quarter of the town.

The Executive Engineer is absent from head-quarters at present, having gone to Tavoy on inspection. It is to be hoped he will not catch the much dreaded Siam fever when inspecting the Siam-Bangkok Road. Mr. Blacker, Assistant Engineer, who lately died in Upper Burma, caught the fever which carried him off when out on this road, and I know of many others also who were employed on the construction of this Siam Road, and who are now mere skeletons of their former selves.

The woodwork for the new swing bridge to be put up at the old Avajee wharf has been completed, and I hear that Mr. Campbell, who has to put up the ironwork, will have it all finished in a short time. This finished, all our river-side works will have been completed, except the extension of the Strand Road, which, as I stated in my last, is doomed to remain in *statu quo*.

Nothing fresh about the Martaban Beeling Railway. One of the partners of the Salween Navigation Company is expected from England shortly, and doubtless he will be able to say something about it on arrival.

MAULMAIN; January 10, 1888.

DEXTER.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, January 7, 1888.

Upper Burma.

With reference to Burma Notification, dated the 16th December 1887, Mr. H. Kench, Executive Engineer, 4th grade, temporary rank, reported his arrival at Mandalay on the forenoon of the 27th instant, and is posted to the Ruby Mines Division.

Mr. J. W. L. Tooze, Assistant Engineer, 1st grade, under transfer from India, reported his arrival at Mandalay on the forenoon of the 27th instant, and is posted to the Ruby Mines Division.

Mysore, January 7, 1888.

Mr. C. M. Anandathirra Rao, who returned to duty on the 7th instant, having passed the L. C. E. Examination at Poona, he is brought on the permanent establishment as an Assistant Engineer, 3rd grade, with effect from that date.

Madras, January 10, 1888.

The following reversion is ordered:—Mr. J. J. Whiteley, from Executive Engineer, temporary rank, 4th grade, to be Assistant Engineer, 1st grade, with effect from 13th December 1887.

Punjab, January 12, 1888.

Irrigation Branch.

Mr. J. H. Brooke, Executive Engineer, 4th grade, temporary rank, from the 5th Division, Sirhind Canal, which he left on the afternoon of the 6th December 1887, to the Chenab Canal Division, which he joined on the afternoon of the 13th December 1887.

Bombay, January 12, 1888.

Captain E. C. Spilsbury, R.E., Executive Engineer, 4th grade, passed an examination in Marathi according to the Higher Standard.

India, January 14, 1888.

The services of the undermentioned officers of the State Railway Establishment are placed at the disposal of the Bengal-Nagpur Railway Company:—

Mr. E. J. Moore, Executive Engineer, 1st grade, sub. *pro tem*.

Mr. T. W. Bartlett, Executive Engineer, 2nd grade.

Major W. Sedgwick, R.E., Executive Engineer, 1st grade, Deputy Consulting Engineer for Railways, Calcutta, is granted special leave for one year and 291 days, with effect from the 15th March 1888, or such subsequent date as he may avail himself of it.

Colonel K. A. Jopp, R.E., Superintendent Engineer, 3rd class, temporary rank, State Railways, reverted to his substantive rank of Executive Engineer, 1st grade, with effect from the 18th November 1887.

Mr. A. E. Rose, Assistant Engineer, 1st grade, North-Western Provinces and Oudh, is temporarily transferred to Beluchistan.

Military Works Department.

Lieutenant J. W. Pringle, R.E., passed the examination for promotion to Assistant Engineer, 1st grade, prescribed in the Public Works Department Code.

Director-General of Railways.

Mr. C. S. Killick, Assistant Engineer, 1st grade, is transferred, in the interests of the public service, from the Cuddapah-Nellore State Railway, to the North-Western Railway.

N.-W. P. and Oudh, January 14, 1888.

Irrigation Branch.

Mr. G. E. Coles, Executive Engineer, 3rd grade, is, on return from furlough, posted to the Nadrai Aqueduct Division, Lower Ganges Canal.

Bengal, January 18, 1888.

Establishment—General.

Rai Madhub Chunder Roy Bahadur, Officiating Inspector of Local Works in the Dacca Division, is granted privilege leave for fifteen days, with effect from the 24th instant.

The officers named below were transferred from the late Rajshahye to the Darjeeling Division, with effect from the 8th September 1887:—

Rai Kali Prosonno Mukerjee Sahib, Executive Engineer.

Rai Aghore Nath Mukerji Sahib, Assistant Engineer.

His Honor the Lieutenant-Governor is pleased to make the following reversion in the Engineer establishment, with effect from the 21st November 1887:—

Mr. W. B. Gwyther, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade.

Railway.

Baboo Russick Lal Roy, Assistant Engineer, 1st grade, is, on return from privilege leave, posted to the Assam-Bihar State Railway, which he joined on the afternoon of the 11th January 1888.

BRITISH INDIA has now upwards of 23,000 miles of telegraphs, and the Eastern colonies have about 1,500 miles more. Australasia has more than 33,000 miles, Canada has 17,000, and South Africa about 8,000.

THE Royal Engineers have so multiplied of late years that it is very difficult to find room for them in Chatham. The Sub-Marine Mining Battalion occupy St. Mary's Barracks, and half of Chatham Barracks is occupied by Service Companies.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 11th January 1888.

- 102 of '87.—Kally Sunker Dass, of No. 15, Kasaripara Road, Bhowanipore, in the Suburbs of the Town of Calcutta.—*For improvement in carriages.*
- 107 of '87.—Russick Lall Bose, of 52, Bowane Churn Dutt's Lane, Sankee Bunga, Calcutta.—*For improved Indian Stoves or Choolas.*
- 183 of '87.—The Roburite Explosives Company, Limited, of No. 59, Old Broad Street in the City of London, and Kingdom of England.—*For improvements in the manufacture of explosives.*
- 190 of '87.—Thomas Cooper John Thomas, Engineer of Finsbury Park, in the County of Middlesex, England.—*For improvements in gas lamps.*
- 208 of '87.—Charles Ewing, Civil Engineer, of Barrackpore, near Calcutta.—*For machinery to be used with manual, steam, gas, water, falling weights, or any other available power for pulling punkahs, but which may also be used for any other purpose requiring power to be applied in a similar manner.*
- 226 of '87.—John Henry Brown, Engineer, of New York City, New York.—*For improvement in process and apparatus for disintegrating fibrous materials.*
- 235 of '87.—George Jones Atkins, of Tottenham, in the County of Middlesex, England, Electrician.—*For new or improved means and apparatus for the separation of gold and other metals from their ores.*

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P.W.D., Punjab, Fellow of the Punjab University.

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EDITORIAL ANNOUNCEMENTS.

AN Index of the contents of Volume II. with a title page will be issued at an early date next month.

Contributors would doubly favor us by having any drawings or sketches that may accompany their articles prepared of a size to suit the pages or columns of the Journal.

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INDIAN ENGINEERING.

SATURDAY, JANUARY 28, 1888.

IRRIGATION IN THE PUNJAB.

OWING to its natural features the Punjab is a veritable hard nut for an Engineer to crack, and it is there that the science of Engineering has achieved its wonderful conquests. Intersected by treacherous rivers, ravines and hills, it presents obstacles to the prosecution of works of public utility which are rarely to be met in any other province in the Empire, but nevertheless it abounds with structures that are the admiration of travellers from Europe and America. To say nothing of the magnificent bridges that span its historic streams, let us turn to its canals to see what beneficent influence they exercise in scattering plenty through a barren land. These are divided into perennial, such as the Swat River, Western Jumna, Bari Doab, Sirhind and Chenab; and others which are of an inundatory character, such as the Lower Sohag and Para, Sidhnai, Upper Sutlej, Lower Sutlej and Chenab, Indus, Muzuffurgurh and Shahpore. Of the former there are 1,330 miles, besides 5,034 miles of distributaries, and of the latter 2,440 miles, besides 641 miles of distributaries. In the year 1886-87, 1,011,061 acres were irrigated by the Perennial Canals, and 939,579 by the Inundation Canals, making a total of 1,950,640 acres, or 25,000 acres more than in 1882-83. There has been satisfactory progress on the Perennial Canals, and it will be probably maintained as the irrigation on the Sirhind Canal has been increasing faster than was expected. This also applies to the Swat River Canal as the water was taken very largely during the rabi season, when there was no rain. In regard to the Inundation Canals, the area watered by them depends to a greater or less extent on the floods in the rivers, as the heads are open, and the water in the streams uncontrolled; but the new Sidhnai Canal, which has a weir across the Ravee at its head, irrigated 27,162 acres in the first year out of an estimated total area of 64,000 acres, and in the present official year there may be a large increase. The principal crops which have enjoyed the advantage of irrigation during the past five years are sugarcane, rice, jowar, maize, wheat and cotton, but principally wheat which covered an area of 747,514 acres, the largest on record. The area occupied by cotton is also steadily increasing. The estimated value of crops grown on the canals during the period under notice is Rs. 5,67,58,501. Taking the Perennial Canals, and leaving out the Inundation Canals, the crops on which are helped by well irrigation, the average value per acre is Rs. 31-72, while the average water-rate per acre is only Rs. 3-03, or less than one-tenth. The supplies in the rivers were abnormally low during the decline of the year, and the whole of the supply of the Sutlej was diverted to the Sirhind Canal. The floods of 1886 severely damaged the scouring sluices at the head of the Baree River, but subsequently they were repaired, and have successfully withstood the floods of last year. The capital outlay during 1886-87 for Protective Irrigation Works, Swat River, is

Rs. 1,06,505; for irrigation works not charged against revenue Rs. 20,19,259; for minor works and navigation not classed as productive Rs. 13,502; contribution (Sirhind Canal) Rs. 9,84,654. In addition to the above, a sum of Rs. 49,401 has been added to the previous outlay on works not charged against revenue on account of survey works up to the end of 1878-79. The assessments have risen from Rs. 43,72,780 in 1885-86 to Rs. 47,03,575; the working expenses from Rs. 21,85,744 to Rs. 23,77,640; and the profits from Rs. 21,87,036 to Rs. 23,25,935. Excluding the Mozuffurgurh Canals, which have no capital account, the profits shew a return of 3·70 per cent. on the total capital outlay at the end of 1886-87, against 3·61 in the previous year. Taking the Protective and Productive Works, on which alone interest is charged, the assessments have risen from Rs. 30,80,956 to Rs. 33,48,625; the working expenses have increased from Rs. 13,22,049 to Rs. 14,37,600; and the profits from Rs. 17,58,907 to Rs. 19,11,025. The return on the capital outlay to the end of the year under review is 3·44 per centum against 3·29 for 1885-86, and the profits fall short of the interest charges by Rs. 1,71,487. If the Swat River Canal, which is a Productive Work, be excluded, the return is 3·63 per cent., and the deficit only Rs. 56,572, or rather less than the interest charges on the Chenab Canal, which has not yet been put in operation. The amount collected under Protective and Productive Works is Rs. 32,07,249, and after deducting Rs. 14,37,600 for working expenses, there is a balance of Rs. 17,69,649 for the purpose of meeting interest charges amounting to Rs. 20,82,512, the result being a deficit of Rs. 3,12,863. Excluding the Swat River Canal, the deficit is reduced to Rs. 1,56,500. The total net revenue from Protective and Productive Works which have been in operation up to the close of 1886-87 amounts to Rs. 4,86,30,956, and the total interest charges, and the total charges on account of interest, after the alterations had been carried out as ordered by Government, to Rs. 2,96,84,023, so that the balance of net revenue was Rs. 1,89,46,933; at the end of 1885-86 it was Rs. 1,92,59,796. But this falling off is only temporary, and will cease with the development of the irrigation on the Sirhind Canal. The working expenses of Protective and Productive Public Works amount to Rs. 14,37,600 against Rs. 13,22,049 in the previous year, and the rate per acre irrigated is Re. 1·36 against Re. 1·42; the increase in cost is partly due to increased charges in the revenue account on new canals, and partly to heavy outlay on the Baree Doab Canal Headworks. Attempts are being made to reduce the expenses of the Western Jumna Canal which are at present rather high. The expenses of works not classed as productive amount to Rs. 9,40,040 against Rs. 8,63,695 in 1885-86, and the rate per acre is Re. 1·05 against Re. 1·02. The cost of working the Upper and Lower Sutlej systems has increased, owing to improvements in the canals. In the matter of miscellaneous receipts, the year 1886-87 ranks third in the last five years with Rs. 2,28,470. During the kharif of 1886-87, the Sidhnai Canal was opened, but only moderate supplies could be run in it, as the banks being new, irrigation was carried down to the crossing of the North-West Railway, and owing to the water-courses having been completed

beforehand a satisfactory start was made. The Resolution goes on to say that the Native States' branches of the Sirhind Canal were practically completed during the year, and a large number of distributaries were made over to the States for irrigation. The area irrigated from the Native States may be roughly put down at 57,000 acres, as nothing accurate is known about them, and the assessments at Rs. 98,875. Last year surveys were made for a canal from the left bank of the Jhelum, and for the Sirsa (kharif) branch of the Western Jumna Canal, which have been almost completed. In conclusion the Resolution says:—"The Punjab presents an unrivalled field for irrigation projects; there is water, land of good quality and sufficient surplus population to cultivate it, while the scanty and uncertain rainfall makes irrigation a necessity, and guarantees steady returns."

KATTYWAR AND PROGRESS.

PARADOXICAL although the statement may seem at first sight, it is nevertheless true that a backward Indian province has better chances of sliding into progressive grooves, than one in which the people have done what little they could to help themselves in the onward way. The deficiencies of the backward province, its incompatibilities with and fallings away from latter day administrative ideals of propriety, are then by force of surrounding circumstance strongly marked, get accentuated by comparison with the behaviours of other provinces, become a shame and reproach to men having local authority and to unofficial district notables aspiring to be Rai Bahadurs or Nawabs.

Some fine day, possibly by virtue of a strongly worded hint from some Secretary to Government, both these classes wake up to a realization of district shortcomings, and then the pursuit of progress and reform is entered on bald-headed, and what was a backward province soon outstrips, and leaves behind in the race for progress those that used to be esteemed forward ones.

The Punjab was an instance in point, thirty years ago. What had been a few years before Runjeet Singh's big barbarian camp, bigotedly conservative, and opposed to all utilities, had been therefore taken in hand *con amore* by Anglo-Indian reformers, and had become a pattern State, a model held up before the rest of India for admiration and example. Fifteen years ago Behar was a byword of backwardness, a reproach to the local Government, and to Beharees at large.

By way of remedy railways were introduced into the province, and in the matter of those wealth and wisdom promoting agencies, Behar is now better served than any other part of Sir Steuart Bayley's satrapy. Of late years it has been backward Kattywar's turn to get fillips and encouragements in the way of progress. Trade to Kurrachee has been fostered, extensive harbour works have been constructed for its behoof, railways have been made, and are being made, to subserve Kattywar interests. In a week or two, the line connecting the Bhownuggur-Gondal Railway with the sea at Verawal will be open for traffic to Junagadh. *Apropos* of the benefits it brings in its trains the *Bombay*

Gazette wrote in a late issue:—"We are within measurable distance then of the connection of the present main line of Kattywar with the sea at three ports—Bhownuggur, Verawal, and Porebunder—a fact whose bearing upon the economic development of the province is not likely to be under-estimated. Three at least of the most productive of the cotton growing States of Kattywar will then be in communication by a short and direct railway and sea transit with the Bombay market. The first result will doubtless be that a larger area of the rich black soil which abounds in the province will be brought under cotton cultivation. There is still a good deal more land in Kattywar than the cultivators have as yet known how to farm profitably. Increased accessibility to distant markets will raise local prices, will stimulate production, and lead to the prosperity of the Kattywar Durbars and their subjects.

Some six weeks ago Lord Reay turned at Doraji the first sod of the Porebunder Railway, which is estimated to cost about 33 lakhs of rupees, and which, starting from Doraji, the present terminus of the Bhownuggur-Gondal line, will tap the trade of such important business centres as Superi, Upleta, Bhayawardar, Jodhpore, and Ranarao. It is hoped that some modification of the Hyderabad-Pachpadra Railway scheme may yet develop it into practical utility.

The Morvi State Railway, a two feet six line, which runs from Wadhwan to Morvi, and runs cheaply, its first thirty miles of rail being laid down on the high road, is about to be extended by a branch from Wankaner to Rajkote.

Then there is a hopeful project for a Wadhwan-Sidhpur Railway, towards construction cost of which the Maharaja of Bhownuggur offers to contribute fifteen lakhs of rupees, having probably in his mind's eye some notion of making Bhownuggur serve as a port for Rajputana.

Upon its harbour a good deal of money has been spent—judiciously, and to good purpose. For the port does a brisk trade, and is steadily growing in importance and value. In that connection we are told that Mr. Proctor Sims, the State Engineer, has matured plans for the construction of a port landing stage, moving upon wheels and rising and falling with the tide—a convenience which is expected greatly to facilitate the loading and unloading of coasting steamers. It is suggested that a convenient site for a dock for ocean going steamers may be found at Bhownuggur near the lighthouse. Last year the exports from that port were valued at Rs. 1,08,94,000, and 89½ lakhs worth of imports passed through it.

Within the last eighteen months some of the hoardings of the late ruler of Porebunder have been expended on the erection of a lighthouse, and construction of a broad road along the sea face of the town. Several smaller thoroughfares have been opened out in connection with the Bunder road, and a highway has been made to Aditana, where are the famous stone quarries—a first-class work this, regularly graded throughout with extra strong bridges. It is hoped that a steam tramway will run along it before long. The necessary rails could be laid down cheaply; working expenses would be light; and experts are of opinion that a tram line would be sure to pay.

Porebunder's Jubilee Memorial is an embankment crossing the creek. That strikes us as very much more sensible than a contribution to the Indian Institute at Kensington.

Sketchy and incomplete although the due limits of a newspaper article compel this writing to be, yet enough has been written, we take it, to justify the paradox that has served us for text. Kattywar, only the other day so backward in all matters affecting material progress, bids fair soon to become, is fast becoming, Kattywar the forward in all good works. The Rajcoomar College has helped somewhat towards this satisfactory result for the province; but the reproach of its fatuous backwardness has helped much more.

DISTRICT BOARDS IN THE CENTRAL PROVINCES.

It is a happy sign of the times that our fellow subjects are beginning to realise the fact that the boon of self-government has been conferred on them, not with the object of testing their powers of elocution, but to educate them in the management of Municipal affairs. This is not an innovation in the strict, if not narrow, sense of the term, for the village or *punchayet* system has been known here from time immemorial. To some extent there was a breaking up of those institutions since the time of the first Muhammadan conquest in the tenth or eleventh century of the Christian era; and with the advent of British supremacy there have been yet more startling changes, consistent with Western ideas, but unknown to the people of the country. The elaborate system of Municipal government with its Commissioners and Local and District Boards point to an earnest desire on the part of the State to instruct the 'masses' in the art of self-government. To recognise the responsibilities attaching to the duties of Local and District Boards is one of primary importance, and the members would do well to direct their attention to them. On such subjects reticence in superior authorities is not commendable, and we are therefore glad to find Mr. Mackenzie, Chief Commissioner of the Central Provinces, in his usual outspoken way, reminding the District Councils of what they ought to do.

In a recent issue of the local *Gazette* we observe that the total expenditure on roads was Rs. 1,26,611 (original works Rs. 57,106 and maintenance and repairs Rs. 69,505) or about Rs. 13,000 less than the budget estimate of road cess, while the receipts from road cess were Rs. 1,43,549. Now the principle generally acknowledged is that the expenditure on roads should at least equal the income derived from the above-mentioned cesses. But some of the District Councils shewed a lamentable failure in realising the principle. For instance, at Nagpur the income was Rs. 17,910 and the expenditure Rs. 8,130; in Betul the income was Rs. 3,870 and expenditure Rs. 703 only; in Raipur the income was Rs. 16,890 and expenditure Rs. 4,782. In the cases of Nagpur and Raipur the failure is ascribed to the "non-existence of a suitable professional agency for carrying on work away from headquarters." But the Chief Commissioner is inclined to believe that the main cause of these shortcomings, at least

in the matter of repairs, is attributable to "undue centralization of work and to the District Councils neither undertaking to carry out the requirements of the more remote localities nor permitting the Local Boards to execute the works themselves."

Mr. Mackenzie calls upon the public to co-operate with District administration in carrying out such works of local utility, as the erection of serais, the improvement of water-supply, &c.,—for which no separate cess is levied. In order that the burden should fall on all alike he suggests that the public assist with "cash, material or labour," so that if such help were systematically sought there would be no necessity for District Councils to bear the entire burden, but to confine themselves to grants-in-aid. This plan, it need hardly be said, will leave a large sum of money unfettered in the hands of the Councils which might be appropriated for other useful purposes. In this connection it might be said here that the *malguzars* of the remote Bilaspur district have set a brilliant example, not only to the Central Provinces, but to the whole of India.

The subject of village sanitation is not overlooked. The Chief Commissioner very properly remarks that unaided official action could not accomplish much without the active co-operation of District Councils and Local Boards, which should, in concert with the executive, work the simple sanitary rules drawn up by Mr. Crosthwaite. Already some progress has been made in this direction, but a great deal more remains to be done. A new departure has been inaugurated in regard to agricultural exhibitions, as directed in a circular of the Government of India, that instead of awarding money prizes to successful competitors improved agricultural implements and good live stock should be distributed among them. Reports from Warda, Hoshungabad and Betul shew that the suggestion has been acted upon, and which should be followed more largely throughout the Provinces. In order to create an interest in the subject, the Chief Commissioner throws out a hint that representatives of the agricultural and mercantile communities on Local Boards could render valuable assistance to that Department.

The quality of the local works carried out is favorably commented upon, but there has been some delay in repairing roads, to which the serious attention of the Boards is invited, as such dilatoriness cannot but tend to inconvenience the public and interrupt traffic. They are also reminded that as under the existing law the Council or Board can dismiss any of their servants who are unfit for employment, this provision might be put in force against those who are apparently incompetent. In conclusion Mr. Mackenzie remarks that in order to provide for a proper system of work the District Council should secure the help of District Boards in the preparation of Budget estimates and the plan of operations for each year. This will enable the former to arrive at a definite conclusion as to which works might be entrusted for execution to the Boards, and which might be retained in their own hands. This division of labor would no doubt tend to facilitate the progress of work through the medium of systematic arrangements, the District Overseer acting under the orders of the Councils for all Boards in the circle.

Notes and Comments.

COMPLETION OF THE OXUS BRIDGE.—The bridge over the Amu Daria at Charjui has been completed, and the first train passed over in safety on the 20th instant.

CAPTAIN GRIESBACH'S VISIT TO CABUL.—It is now definitely settled that Captain Griesbach goes to Cabul shortly to institute Geological explorations for the Amir.

MINERAL FINDS IN SONTALLA.—The *Englishman* says: It is reported that Mr. Agabeg Agabeg has succeeded in finding rich iron ore in quantity, with limestone and coal within easy reach, in his mineral explorations of the Sonthal Parganas.

IRRIGATION IN WESTERN INDIA.—26½ lakhs of rupees were expended on irrigation during the year 1886-87. The total area of lands irrigated from Government irrigation works declined from 57,567 acres in 1885-86 to 40,903 acres in the year under review. There was an increase of Rs. 17,666 in the total water-rate assessment of Rs. 1,78,825.

CHIEF ENGINEER, RAMPUR STATE.—Mr. Wright, much to the regret of many in Lucknow, leaves shortly for the Rampur State, to take up his appointment there as Chief Engineer. That State has decided to embark on a system of public works, and Mr. Wright is to superintend the execution of these works; and perhaps a light railway or two may be included in them as feeders to the Oudh and Rohilkund system.

MYSORE GOLD-MINING COMPANIES.—It is announced that Lord Ribblesdale is to visit Mysore, on behalf of a number of the Mysore Mining Companies, to endeavour to obtain from the Maharaja's Government more favorable terms for the renewal of the mining leases in that State. The leases are only for thirty years, and it is felt by the shareholders that in many cases this term will be altogether insufficient.

A BRANCH LINE OF RAILWAY.—It is proposed to construct a branch line of His Highness' Railway to Raipur in the Central Provinces instead of to Chanda, as it is believed that it would prove a greater success financially. The Agent, Mr. Furnivall, accompanied by Mr. A. J. Dunlop, Inspector-General of Revenue, had an interview with the Minister on the subject on the 13th instant, but it is not known yet what course has been decided upon.

A WHITE ELEPHANT.—Contrary to official expectation, the bulk of the export trade has not been drawn from its old channel by the opening of the Hooghly Bridge. The proportion of downward traffic diverted *via* Chitpur has been comparatively insignificant, as merchants have not availed themselves of the opportunities for shipping produce direct through the Jetties. The Jubilee Bridge at Hooghly is likely therefore to be a "white elephant" till the circle of communication is completed by the opening of the Kidderpur Docks.

ITEMS FROM BURMA.—A Correspondent writes:—Mr. J. Mackenzie, Honorary Assistant Engineer, at present Commander of the river steamer *MacIvor* on the Chindwin, is to be transferred to the Punjab as Commander of the Government steamer *Chenab*. Mr. A. Wernigg, Chief Workshop Foreman of the Burma State Railway, has invented a spike extractor, which is of great utility in removing spikes from sleepers. The Manager of the line was so pleased with it, that he ordered a number to be made up in the Workshop.

THE BENGAL P. W. D. SECRETARY.—The *I. D. N.* learns that it is now definitely settled that Colonel Browne, R.E., Chief Engineer and Secretary to the Government of Bengal, in the Public Works Department, will retire on promotion to Major-General in March next, and that he will, in all probability, be succeeded in both appointments by Mr. E. J. Martin, an officer with a long roll of service in the province, who designed the Calcutta Exhibition of 1884, the façade of Writers' Buildings, the New Treasury Buildings, &c., &c.

A REMARKABLE HAND AT WHIST.—An extraordinary incident in a game at whist, the only *bonâ fide* one of the kind recorded, occurred at the United Service Club, Calcutta, a few days ago. The players were Mr. Justice Norris, Dr. Harvey, Dr. Sanders and Dr. Reeves. Two new packs were opened and were trayed and shuffled in the usual way. Dr. Sanders had one of the packs cut to him and proceeded to deal. He turned up the knave of clubs and on sorting his hand found that he had the other twelve trumps.

PUBLIC HEALTH IN THE BOMBAY PRESIDENCY.—The high death-rate among children of tender years is unmistakeable proof of local insanitation. Year after year the rural inhabitants have the effects of their filthy habits clearly pointed out to them. They are, however, perfectly callous to sound advice and ascribe the prevalence of an epidemic to Divine wrath. Something can be, and is, done in Municipal towns, especially the larger ones. Want of funds in the smaller towns is very often a hindrance to effective sanitary measures.

AN ENGINEERS' LIBRARY—WANTED.—Few could have felt this want in Calcutta more than ourselves. We have often been at a loss for a reference, and in some cases could only obtain the needed information at the expense of much time and trouble. We are glad, therefore, to learn that a movement is on foot to establish a Professional Library in Calcutta, and can safely predict that should the measure ever be inaugurated it will eventuate in a success—if conducted on a broad basis. We hope to say something more on this subject in an early issue.

WEST DECCAN RAILWAYS.—It is stated that Major Firebrace, Consulting Engineer to the Government of Bombay, inspected the S. M. R. line from Castle Rock to the Portuguese frontier on the 12th instant and pronounced it fit to be opened for traffic. The line accordingly will be opened on the 31st instant to Goa, when Lord Reay will take part in the opening ceremony. It is also expected that the Governor of Goa will shortly meet Lord Reay at Belgaum to discuss the advisability of transferring the management of the W. I. P. R. to the Southern Maharatta Railway Company.

A TRAMWAY FOR GHAZIPUR, N.-W. P.—The Government of India has, we hear, with a view to support the steam ferry plying between Tarighât and Ghazipur, sanctioned the construction of a tramway from the station to the river bank for both goods and coaching traffic. The preliminary operations connected with it have already been finished, and the work will, it is said, commence early next month. The rates, etc., and the description of traffic by the new scheme are as yet unknown; but we are told that the subject will be discussed at a meeting to be convened in the town hall very shortly.

CALCUTTA P. W. D. WORKSHOPS.—We have always viewed Government workshops with disfavor, and such establishments are an anomaly side by side with

larger and better private concerns struggling for an existence under the hard circumstances that beset them. It is therefore with much satisfaction that we learn that the Seebpore Workshops will soon cease to exist as an expensive, useless establishment. But it will serve a more useful purpose as a College Laboratory—a Technical School only—for affording instruction in the Mechanical Arts—a *bonâ fide* adjunct to the proposed Bengal "Polytechnic."

BOMBAY MUNICIPALITY—1886-87.—In connection with the water-supply of the city great progress was made with the work of detecting and checking waste of water; a daily saving of 600,000 gallons was effected, and when the full sanctioned staff is employed it is expected that 21·2 million gallons a day ($\frac{1}{4}$ th of the present supply) will be saved. Excellent progress was made with the various sewerage works of the city. 23 lakhs of rupees have been spent since 1878 on completed sewerage works, and works to cost 21 lakhs when completed were in progress during the year under review. Many important street improvements were effected.

ANOTHER JUBILEE MEMORIAL.—The foundation stone of the "Victoria Jubilee Museum Hall," which the States of Kattywar voted as a memorial for perpetuating in Rajkote the Jubilee of Her Majesty the Queen Empress of India, was laid with much imposing ceremony on the 9th instant, by Colonel Wodehouse, C.I.E., the Political Agent, in the presence of a very large gathering. One lakh and sixty thousand rupees have been subscribed by the States to be devoted to the construction and endowment of the Hall; and the site selected is very good. The building has been designed by Mr. R. F. Chisholm at the estimated cost of Rs. 1,05,000. The construction is entrusted to Mr. R. B. Booth, the Agency Engineer.

PINE-APPLE FIBRE.—It is beginning to be said that the leaf of the pineapple plant (*ananas sativa*) has a future before it, and it goes without saying that if the leaf is cared for the fruit must be cared for with it. It is said now that the leaf is finer and stronger in fibre than that yielded by any other plant, and that, in the Philippines, where the West-Indian *ananas* has become naturalized, a beautiful and strong textile fabric is made from it, known locally as "pinacloth." A sample of Trinidad *ananas* fibre was lately reported on by London brokers as follows:—"Not yet in commercial use, but destined we think to a successful future; fine, soft, supple fibre; strong and good, and ample strength, say £30 per ton and upwards."

DIAMOND SEEKING IN HYDERABAD.—The Secunderabad paper states that it has been decided by His Highness' Government that under the Articles of Agreement between it and the Hyderabad Mining Company, no washing for diamonds or other precious stones is on any account to take place without an officer deputed by Government being present. As Mr. Lowinski, the Company's Mining Engineer, purposes to have a series of washings on the diamond fields at an early date, Mr. Syed Ali Belgrami, the Government Director-General of Mines, has been directed to start at once for Partyal, to be present at every washing that is about to take place, and to report the result of each successful operation immediately in the minutest detail to the Government.

A PATENT CASE AT CALCUTTA.—A rather important patent case was under trial at the Calcutta High Court. The points at issue are that the well-known firm of Messrs. Thomson and Mylne, the zemindars of Beheea, have

been appropriating as their own invention the now widely-known Beheea Sugar Mills, whereas they had no right to claim patent rights for the said machine, which is an invention of another individual. They were therefore called upon to shew cause why the exclusive privilege granted to them should not be cancelled, and made null and void. The Court found that the real mover in the case was not in a legal position to question the patent, and on the authority of the case *Clark vs. Aide*, which had been cited, the rule was discharged on that objection alone.

VOLUNTEERS HEAD-QUARTERS BUILDING, CALCUTTA.—We regret that some mistakes should have crept into the paragraph on this subject in our last issue. We learn that Mr. Garlick is not known by the Volunteers in this matter. Such drawings as were prepared by him were for Messrs. A. and J. Main and Co., and not for the Corps. When a *pucca* building was proposed a Sub-Committee consisting of Colonel Chatterton, Sergeants Girard and Leslie, and Volunteers Webb and Palmer was appointed to prepare the plan; and it was under these circumstances that Mr. Palmer submitted a design as a *Volunteer*, and not for remuneration as our paragraph might imply. It has been decided to have a *pucca* building, and tenders will be called for by the Sub-Committee in the usual way.

AMERICAN INVENTION.—The Americans are a restlessly ingenious people. Every week the United States Patent Office publishes a gazette of about 120 pages quarto, containing specifications of new inventions—four to the page on an average—many of which are in one way and another curious. For instance, in the issue for August the 2nd, 1887, claims are registered for patents for an electrical ore-detector, a stocking-supporter, a carpet sweeper, a combined egg tester and register, a wire fence machine, an apparatus for aerial photography, an armpit dress-shield "the body of which has one of its surfaces composed of rubber fabric supplied with a permanently attached piece or pieces of chamois that has been steeped in a solution of liquid deodorizing and perfuming substances."

MORE ITEMS FROM BURMA.—Considerable progress is being made with the cart-road to the Ruby Mines. The difficulty of obtaining labor, which a short time ago threatened to seriously delay the work, has been much lessened. Numbers are being shipped off from Mandalay by the Public Works Department to work on the road. The twenty-five miles of road from Setchang, above Kendat, on the Chindwin, to Tammu, on the Manipur frontier, to connect with the mule track from Assam, is now being pushed forward. Telegraphic communication to Tammu from Assam side is complete, and on this side of the frontier several parties are at work carrying on the line to Tammu, and it is expected that direct telegraphic communication with Assam will soon be established. There is talk of a railway from Mynmoo across to Alon to facilitate the movement of troops and traffic up the Chindwin, as during the cold weather the navigation of the Chindwin below Alon is very uncertain.

LETTING PROFESSIONAL WORK TO THE LOWEST BIDDER.—An American paper says that advertising for engineering brains and estimating their capacity at the valuation put upon them by the bidder, that is, the lowest market price, is about as wise as advertising for sealed proposals for medical, or spiritual treatment, or legal advice. In either case it is the advertiser that will ultimately suffer, in pocket, health, or spiritual and worldly affairs. No good engineer, except from dire necessity

would enter into such a competition: and while the advertiser may accidentally obtain able service from some man who is competent but otherwise "down on his luck," the probabilities are strongly against such an event; and even then they will be most likely to get the full measure of the accepted fee—but no more—whatever the conditions may demand. The true value of the position of a true engineer cannot be estimated in dollars, and you can never buy one at an auction.

THE PHOTOGRAPHIC EXHIBITION AT CALCUTTA.—The Photographic Society of India's exhibition of photographs was opened on Wednesday, the 18th instant, by Her Excellency the Countess of Dufferin. One of the features of an exhibition of this kind in the present day is undoubtedly the variety of processes by which photographs are produced from the negative, and the exhibition in Calcutta is no exception to this. There are excellent specimens of prints produced in platinotype, on bromide paper, and on Ingles' argentic paper, all producing effects more or less similar to engravings, and which, unlike prints on the well-known silver paper, are permanent and do not fade. The exhibits of the photo office of the Survey of India included specimens of Photo-Calotype, Heliogravure—photo-electro process, and Heliogravure—photo-etching process. The value of this collection, which was not for competition, was enhanced by plates and descriptive slips shewing the different stages of production, and was altogether the most instructive section of the show.

KURRACHEE HARBOUR BOARD.—The receipts of the Kurrachee Harbour Board last year amounted to about 18½ lakhs of rupees, while expenditure to the amount of 13 lakhs was incurred. The increase in the receipts of 7½ lakhs as compared with those of 1885-86 was chiefly accounted for by increased loans received from Government. Pilotage fees and port dues were reduced, and there was a decrease in the receipts from this source, as also in those from wharfage fees, due in the latter case, to the general depression of trade during the year, which has been noticed elsewhere. Large amounts were spent chiefly from loans advanced by Government, on wharfage and harbour improvements. A sum of ½ a lakh of rupees out of a loan of 15½ lakhs from the Imperial Treasury was taken up during the year, and spent on wharfage improvements and deepening the entrance to the port. A special grant of 3½ lakhs was also made by the Government of India for further harbour improvements. The work for Government in the shape of landing of troops and stores was heavy.

IRRIGATION AND RAINFALL IN SOUTHERN INDIA.—The average rainfall last year for the Madras Presidency, excluding Madras, the Nilgiris and the two West Coast districts, was in excess of the average of the preceding five years, and that of the previous year by about five and six-and-a-half inches, respectively. From May to October the rainfall was abundant and seasonable, but the north-east monsoon was generally deficient, except in the four northern districts and Kurnool, where it was marked by excessive rainfall, which caused considerable damage to crops and breaches in the canal and tanks under it. In Godavari there were several breaches in the canals and the Dowlaishweram lock fell, causing a temporary interruption to navigation. The flood rose 16-90 feet over the crest of the anicut and was the highest on record. In Kistna the delta taluks suffered greatly owing to imperfect drainage. Owing to the favorable character of

the season generally there was an increase in the area irrigated under all the irrigation systems, except the Penner and the Srivaikuntham anicuts and the Madras Water-Supply and Irrigation project. The decrease in these instances was, however, unimportant.

THE WATER-SUPPLY OF TANJORE.—The proposed scheme of Mr. Hughes has one serious defect. It is partial. There are also other objections which vitiate even this partial scheme. Mr. Hughes, for instance, calculates the consumption of water at 5 gallons per head; and this appears to be too little. When water is to be had for the mere asking (which will be the case if the project is carried out) the expenditure will be great. Again, Mr. Hughes goes on the supposition that the supply of the tank by rainfall is sufficient for the whole demand. This does not eliminate the element of chance. In times of drought, Mr. Hughes proposes to sink wells either in the tank, or in close proximity to it; but he has misgivings whether the supply of the wells will be either good or adequate. In order to obviate the first objection, Mr. Hughes proposes to pump up water from the Vennar, and distribute it to the whole town. But the cost of the scheme is enormous, nearly ten lakhs, which is twenty times the annual revenues of the Municipality. Under the circumstances the Council resolves to put off the question, relying on make-shifts in case of emergencies. The Council regrets that it is unable to adopt Mr. Hughes' general scheme on account of its numerous drawbacks.

LANDES AND DUNES.—Dunes are formed by the combined action of the wind and sea. Each ebb tide leaves a quantity of sand, a portion of which dries before it is covered by the next flow, and it is then liable to be blown away by the wind. Thus sand hills or dunes are formed, the line of their crests being generally perpendicular to the direction of the prevailing wind. The sand hills themselves are kept moving slowly landward by the wind, which drives the upper layer of sand from the gently sloping outer face up to the summit, whence it falls down the steep slope on the landward side, and thus the dunes are rolled inland by slow degrees. Along the East Coast of the Southern portion of India, close to the sea, there is generally a line of sand dunes, between which and, frequently, a second line of dunes, there is a hollow which may be taken as the result on the extension of the coast line eastward due to the silt, &c., brought down by rivers into the sea. These hollows, frequently forming back-waters, are filled with water, and are of sufficient depth in many places for navigation, being supplied with water, through the bars of the rivers with which they are in connection. These natural features have been taken advantage of in the formation of the Buckingham Canal.

SINGARENI—AGAIN.—The Hyderabad correspondent of a contemporary says :—On the 15th, Mr. Furnivall, Agent for the Railway and the Mining Company, took Mr. Cordery, Colonel Marshall, Messrs. Mahdi Ali, Abdul Huk and several other gentlemen to inspect the new line and the coal-fields. The party arrived at Warungul at 3 o'clock and visited the old Jain temples at Hanamcoonda and the Warungul Fort, after which they went down the new line, reaching Yerandalapadu, the mineral terminus, at daylight. On the 16th they were met by Mr. Hughes, of the Geological Survey, and Mr. Phillips,

the Engineer of the Mine. The present shaft, down which the whole party descended, is only about forty feet deep. Galleries have been excavated to the extent of half a mile and are being rapidly pushed forward. Another shaft is being sunk and the output will daily increase. There is every prospect of a large revenue from these mines, as the coal is of excellent quality and practically inexhaustible. The line passes through forests of ebony, iron and satin-wood. The value of the timber is greatly enhanced now that the railway affords cheap carriage. The Bezwada Extension was not visited, as the line will not be open till the spring. The party returned on the evening of the 16th.

INTERNATIONAL SANITARY CO-OPERATION.—After the cholera epidemic that, in 1884, desolated Naples the Municipality there went in for a pure water-supply; and got it. With result that, in what used to be a cholera head centre there was absolute immunity from the plague for two years, and that this year its incidence has been very slight. The moral seems to be that the Engineer is, while, a better, more efficient physician than the licensed practitioner of medicine. The International Sanitary Congress that has lately been holding its sittings at Vienna does not seem to have quite recognised this fact. The worst of congresses and juries is, that there are sure to be in the unregenerate body one or two pigheaded, unreasonable dissentients to any sensible proposal, who are able to nullify decisions arrived at by a common-sense guided majority. One point in favor of common-sense was, however, gained at the Vienna Congress. To wit a decision that the Continental system of quarantine is idle, foolishly obstructive bosh, and must be put away in favor of the system obtaining in England with regard to vessels carrying passengers afflicted with diseases that are supposed to be infectious. We hope soon to hear that the English Foreign Office, taking this Vienna dictum for a text, has warned the Egyptian Government that it will stand no more quarantine nonsense and nuisance at Alexandria.

OFFICIATING MUNICIPAL ENGINEERSHIP, BOMBAY.—We regret to learn that the recent severe illness of Mr. Walton has rendered sick leave in addition to his present privilege leave necessary. As his absence will extend over a year, and may possibly extend to two years, it was therefore imperative to appoint an officer to fill the acting vacancy. The acting Municipal Commissioner therefore proposed that the appointment should be offered to Mr. [Name] is printed in large type, and in most cases an example is fully worked out: in addition, the text is interspersed with small type shewing how the tables were made and other information of useful character. In this connection we might draw attention to the full explanation of the method of determining Azimuth in an outsider to supersede the Deputy Executive Engineers was not only unfair to the latter, but inexpedient otherwise. Sir Henry Morland's counter proposal was that Mr. James W. Smith, the Deputy Executive Engineer, be appointed to act as Executive Engineer during the absence of Mr. Walton on the usual acting allowance under the rules; and that an advertisement be inserted in the newspapers inviting applications for the post of a temporary Assistant Executive Engineer for drainage, on Rs. 700 per mensem, and that the necessary transfer from the Budget allotment of Rs. 500 for pay of an Assistant Engineer be sanctioned by the Council. On this being put to the vote it was carried, Colonel Merewether being the only dissentient.

Current News.

It is understood that a trial is to be made of a system whereby convict labor may be utilized in the making up of military clothing.

COLONEL CONWAY-GORDON, Director-General of Railways, is quite well again; he passed through Allahabad last week on inspection duty.

MR. STREETER has memorialized the Secretary of State for the first refusal of the Ruby Mines concession, and it is probable the application will be granted.

THE Assam authorities have granted permission to a capitalist at home to prospect for a term of three years for gold, etc., in the Khasi and Jaintia Hills district.

It is proposed to construct a branch line of the Nizam's Railway to Raipur in the Central Provinces instead of to Chanda, as it is believed that it would prove a greater success financially.

WE hear that it is in contemplation to construct a light railway from Mattra to Bindrabun. The line will be constructed by a private company, and the Seths of Mattra will probably find most of the money.

RS. 25,00,000 have been allotted as the Provincial Public Works assignment in the Punjab for 1888-89. The scheme of a railway from the Indus to Bannu has again been under the consideration of Government.

It has been determined to maintain the telegraph line laid from Jamrud to Lundi Kotal in the Khaibar. Light wire has been used so as to lessen the temptation to tribesmen who are short of slugs for their jezails.

THE Directors of the East Indian Railway Company, in their report for the half-year to 30th June, recommend a dividend of £1 5s. 6d. per cent. on the deferred annuity capital, in addition to the guaranteed interest of two per cent.

WE are glad to see that drainage works for Patiala City—upon the necessity for which we have more than once insisted—are being seriously undertaken; and will be carried out through the agency of the Executive Engineer of the Sirhind Canal, whose headquarters are at Patiala.

A REPRESENTATIVE meeting of Uncovenanted officers was held at Rangoon the other day, at which resolutions were unanimously adopted conveying the thanks of the local officers to Mr. King and his committee, and setting forth the well-known grievances and claims of the service.

PROFESSOR SAMUEL COOK and party of students of the Poona College of Science arrived at Bangalore last week on a geological excursion. They will visit Kolar, the French Rocks, Seringapatam and Bellary, having already done Satara, the Gokak Falls and Guntakul. The party travel at the expense of the Bombay Government.

WE are sorry to hear that Colonel J. G. Lindsay, R.E., Chief Engineer and Agent, S. M. Railway, is very seriously indisposed at Dharwar. He had a severe attack of gout and rheumatism on his way from Bangalore to Dharwar and had to be carried from the Madras Railway carriage to the Southern Maharatta carriage at Guntakul Junction.

MR. LEMESSURIER, the officer who was in charge of the now closed Madras State Railway Surveys and his staff, are at once to be transferred to the South Indian Railway for the preparation of the necessary land plans, schedules, and estimates, for the early construction of the Villupuram-Paikul line, which has been deposited to that Company.

TO connect with the mule track from Assam, is now being pushed forward. Telegraphic communication to Tammu from Assam side is complete, and on this side of the frontier several parties are at work carrying on the line to Tammu, and it is expected that direct telegraphic communication will be completed by the same time.

IN their first annual report the Directors of the Bengal-Nagpur Railway Company, Limited, deal with the progress made with the works. It is expected that the entire old line of 149 miles will, before the commencement of the rainy season, in June next, be converted to the standard gauge of 5½ ft., and that about 40 miles of new line will be completed by the same time.

GENERAL FISHER (retired) late Chief Engineer of the Madras Irrigation Works, has submitted a scheme for supplying Bangalore with water which will be discussed at next Saturday's meeting of the station Municipality. A scheme has also been submitted to the Madras Government in competition for the prize offered for the best scheme for supplying the Bangalore troops with water.

THE Chairman of the Madras Railway Company said at the recent half-yearly meeting of the shareholders that "the inwards traffic on the Kolar and Kamasamudrum stations, the principal stations of the gold-fields, continues to increase. The material consigned to the gold mines amount to 9,300 tons paying £4,400 as against 2,300 tons and £1,230 in the corresponding half of 1886.

IN a recent issue we gave some particulars of artesian boring operations in the Kortalar Valley. Government have now

sanctioned a revised estimate, amounting to Rs. 8,745, for further experimental artesian boring of 420 feet in depth, in the Kortalar Valley. If rock be again met with, Government have directed that boring should be stopped, and the matter reported for the orders of Government.

THE Government of Madras, having complained of the quality of certain issues from the Saddlery and Harness Factory, Cawnpore, a special committee will be shortly assembled at Calcutta to investigate and report on the alleged issues of inferior articles of harness and saddlery and Cawnpore-made leather generally. The foreman of tanners and curriers, Harness and Saddlery Factory, Cawnpore, will attend the committee.

BLOCKHOUSES constructed for the defence of railway bridges under the control of the Director-General of Railways will remain in the custody of, and be repaired by, the Railway authorities, the cost of maintenance being debited to the Military Works Department. These blockhouses will be inspected half-yearly by Superintending Engineers, who will after each inspection, if necessary, submit a report to the Inspector-General, Military Works.

DR. SIMPSON, Health Officer to the Calcutta Municipality, accompanied by Mr. Simmons, Honorary Secretary of the Calcutta Public Health Society, and Mr. Swinhoe Vice-Chairman, Calcutta Suburban Municipality, paid a visit to Canning on Wednesday last to see the boring. They were shown round by Mr. Frank Agabeg, M.E., Engineer in charge, who supplied them with all necessary information, and also furnished them with samples of section passed through and water for analysis.

THE official ceremony of uniting the Southern Maharatta Railway with the West of India Portuguese line takes place at Castle Rock, on the frontier, on the 31st current. It will be followed by a banquet given at Marmagao and a dance in the evening. The British India Company run down a special steamer on the 30th, with a large party of guests from Bombay, returning on the 1st proximo. Lord Reay will be present, the Duke of Sutherland and many minor constellations. The affair promises to be a brilliant one, the occasion being something more than of local interest.

THE accommodation for the storage of export produce at Howrah is now being increased by the erection of an additional shed on the south side of the cargo-boat dock. This new shed, 1,000 feet in length, is being constructed by the Engineering Department of the East India Railway, after the manner of the buildings already known as the Dock and Ghat Sheds, of old rails and sleepers, roofed with corrugated iron. When completed it will afford storage rooms for 3,000 tons of grain, and this, with the accommodation previously provided, will enable the railway authorities to store no less than 23,000 tons of produce at Howrah during the coming season. It is confidently anticipated that the new storage shed will be finished by the end of March, or in sufficient time to afford sensible relief during the invariably overcharged months of the shipping season—April, May and June.

Letters to the Editor.

[The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

CONVOCATION OF THE CALCUTTA UNIVERSITY.

SIR,—No careful and observant reader of the Vice-Chancellor's speech at the last Convocation of the Calcutta University can have failed to notice that while so many as 448 B. A.'s, 151 B. L.'s, and 10 M. B.'s, presented themselves for their degrees, there was but one graduate in Engineering. During the 30 years that have elapsed since the University came into existence, we have had only about 100 Engineer graduates, thus giving a percentage of about 3.33 per year. The reason for this poor advance in Engineering you will perhaps say, is the antipathy of the people to low and degrading mechanical pursuits. You will certainly be right, but at the same time I would request you to remember that those few enterprising young men who so far broke through the popular prejudices as to devote their money, energy and the best part of their lives in successfully carrying themselves through the Civil Engineering College in the years 1873 to 1884 were absolutely denied admission in the D. P. W.; and, possibly, this circumstance, more than any other, has chiefly caused the very poor figure that "Engineering" now cuts at our Convocations. It is not a rare sight to see these poor passed men dancing attendance upon Mr. Bestic, or Mr. Spring, for a temporary job on a pay hardly enough to ward off starvation.

NAIHATI; January 16, 1888.

A. C. B.

DEODAR VERSUS STEEL SLEEPERS.

SIR,—I should like to make a few remarks on the paper by Rai Kanhaya Lal, which appeared in your issue of the 14th.

It is to me perfectly astounding that anyone could possibly have the assurance of gravely committing to print such a tissue of absurdities and mistatements, and of supposing for an instant that the professional public would swallow it all down without protest.

The article is entitled "Deodar versus Steel Sleepers," but the belated reader has to wade through over two long columns of to-

tally irrelevant matter before in the 15th paragraph the question at issue is even touched upon.

The writer begins by telling us that the "essential properties of timber for building purposes are strength, hardness, stiffness and durability." We demur to *hardness*, as most of the best timbers, deodar included, are classified as *soft wood*. Then he proceeds to explain for our benefit, what hardness, stiffness, etc., mean, which, as we are not very small boys at school, seems rather *de trop*.

In paragraph 2 we are solemnly told that deodar is superior to other Indian woods in all these attributes, having the additional advantage of cheapness. This is really coming it rather too strong. Deodar, as a matter of plain fact, is distinctly inferior in all these qualities to *sál*, teak, and many other varieties of timber. The tensile and crushing strength of deodar, compared with *sál* and teak, is roughly as 10 : 12, and the transverse as 5 : 7. Its stiffness is less than *chir* and much less than *sál* or teak. Passing over paragraph 3, which contains a little extract from a P. W. specification, we come to the extraordinary statement, that that timber is best suited for sleepers which possesses the greatest stiffness, "for this property of the timber (*sic*) is more essential than mere strength to the stability and appearance of a line of Railway." I can only characterise this strangely worded theorem as rank rubbish. Sleepers if properly packed should be subject to no transverse strain, and if they were an elastic wood that would bend easily, but not break, would be "best suited for purposes of Railway" as our author puts it. In paragraph 5 we are gravely informed that "in selecting timber for purposes of Railway, (*sic*), that which is the most compact, straight, and close-grained, perfectly sound and well seasoned, is to be preferred to that which is the reverse."

Cá va sans dire, one would naturally think, but I never heard of "compact wood" before,—however we live and learn. The next three paragraphs are devoted to a dissertation on the seasoning of wood, though what this has to do with the question at issue, *viz.*, wood *versus* metal sleepers, is more than anyone can fathom.

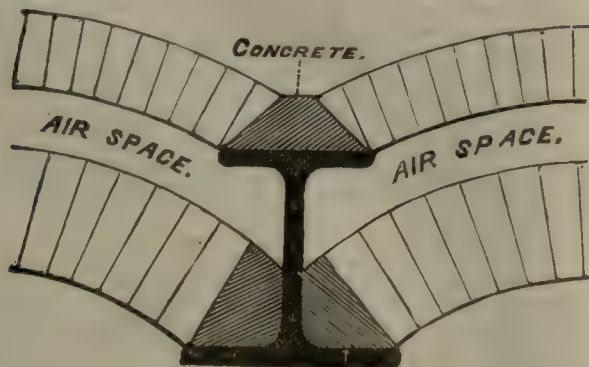
In paragraph 9, we read, "deodar wood on account of its superior stiffness is best adapted for purposes of Railway." I have already shewn this to be absolutely and totally incorrect; in fact, the very reverse of the facts of the case as anyone may see for himself who will consult the Rurki Treatise on the subject of the properties of Indian woods. In the whole of the next column, our writer meanders further and further afield from the subject matter, and gets as far as Kashmir and Solomon's temple, finally winding up with book-cases and wardrobes in Simla and the *dhobie's* iron!! At last he puts down an authoritative statement expressed in very extraordinary language, the pith of which is that he, Rai Kunhaya Lal, M.L.C., is of opinion that deodar sleepers are far preferable to steel, which he adds "are more costly and brittle, *being unfit for Railway purposes*." I am perfectly appalled at the gross ignorance of the subject conveyed in this last sentence, but it is on a par with the rest. I very much fear that this unsupported opinion will not carry much weight with the Profession, and I should recommend the writer, if he has any respect for his own reputation and that of the Institution to which he belongs, to be more careful in future when he rushes into print.

W. G. BLIGH,
Ex. Engr.

A PROPOSED FORM OF ROOF.

SIR,—Your review of 14th January on a new Engineering Work from the Bombay side recalled to my mind a kind of roof and building the merits of which I should much like to see discussed in an Engineering journal.

The roof to consist of rolled iron joists and arches thrown across them, but instead of a single arch I would employ a double arch, as in sketch.



The thickness of arches will of course vary with circumstances, and whether one puts the thick arch above or below may require consideration. Assume that we put the thinnest permissible arches on both flanges and let us consider the advantages of such a roof for this country.

(a) The cracks which give us so much trouble, and which are undoubtedly due to effects of expansion and contraction, would be confined to outside arching made level, if necessary, by filling in between arches with concrete and terracing.

(b) The roof would certainly be very watertight.

(c) The air space, which should be ventilated at both ends of house would form a splendid non-conductor of heat.

(d) The heat absorbed in all day would be confined to outer arching and there would be practically none to radiate "inwards" into the house during the night, which now occurs with both walls and roofs.

This roof has been objected to on the score of expense, which is, indeed, a reasonable excuse, but I presume to think that the amount very often put into ordinary arched roofs might be almost divided into two such arches. We all know how like an oven an ordinary *pucca* building now is in the hot weather. This can be prevented by adopting the above roof and walls built as follows:—

The walls to be hollow with the thin portion inside. Here again we shall have the layer of air as the non-conductor of heat. In England such walls have been, and are, used to keep damp out and warmth in. In this country the object is to keep the heat out, so that at night the warmth of air inside may be a near approach to the temperature of out-door air. Whether the thin wall be inside or outside must depend on the designer. Having the thick wall outside means a greater span for roof than if it were on interior wall, unless indeed this objection is surmounted by bridging across the air space so as to make wall solid at top. For further information see "Notes on Building Construction," South Kensington Series, Part II. A building with outside walls and roof constructed after the foregoing methods would be of great value as a hospital, for instance, and any rich man would certainly get his money's worth in the shape of a cool dwelling place.

NO-SAM.

Literary Notices.

AUXILIARY TABLES TO FACILITATE THE CALCULATIONS OF THE SURVEY OF INDIA. Third Edition. &c., &c. Dehra Dun. 1888.

THE volume before us, though essentially designed for the Survey of India, will be useful to many outside that Department, as its sixty-three tables will be found to meet the requirements of most Surveyors between the Equator and the parallel of 40°.

The first seventeen tables are devoted to the Geodetical determination of Latitudes, Longitudes, Azimuths and Distances from different data and to the Trigonometrical determination of heights. In immediate Sequence Barometrical and Thermometrical determinations of differences of heights are dealt with.

A complete set of tables for the mutual conversion of spherical and rectangular co-ordinates is given, as well as the means of correctly delineating the graticules of maps on different Scales. The remaining tables are mostly of a miscellaneous character and include various Logarithmic Tables and others for the conversion of different linear measures into other units English, French and Russian.

The work is enhanced by an ample explanation to the Tables. In this all that is necessary for a correct manipulation of the latter is printed in large type, and in most cases an example is fully worked out: in addition, the text is interspersed with small type shewing how the tables were made and other information of a useful character. In this connection we might draw attention to the full explanation of the method of determining Azimuths by the observation of circumpolar stars and to the interesting account of the Atlas Sheets of India.

In the Appendix we notice a *new* method of computing differences of Latitude, Longitude and Azimuth in Secondary Triangulations and for the Reverse Process and we recommend it in the latter case to special notice.

The various methods of determining Time, Latitude and Azimuth from Astronomical observations are well chosen from a practical point of view and fully explained. Some useful Trigonometrical formulæ and numerical quantities are added, and at the end of the Appendix a star chart in four sheets is given, which would be more complete if these were supplemented by a fifth giving the stars in the neighbourhood of the pole.

The book has been carefully printed at the Survey Office in Dehra and should find a place on every Surveyor's shelf.

General Articles.

BHAGALPUR WATERWORKS.
SETTLING TANKS.

It was first intended to make these of brick and lime masonry, but the Municipal funds did not admit of such a heavy expenditure, so it was decided to make earthen tanks with one foot of puddle at bottom. The river silt makes a good puddle, and after being a short time in use the tanks will hold water without leaking.

The drawings shew the position of the tanks. Each tank is provided with a floating suction pipe to deliver water from near the surface to the filters.

FILTER BEDS.

Four filter beds have been made. The relative positions and levels of the settling tanks and filter beds and the connections between them are shewn in the drawings.

Gathering drain in filter beds communicates to the clear water well by 18" earthenware pipes by opening slate shutters between them.

PIPING.

From the service reservoir a 12" main will carry the water to the town along the line marked A. C. in printed map. The level at end of main is 121.52 and the mean level of water in reservoir is taken at 180. The discharges, etc., are shewn in separate sheets.

From the 12" main a 4" pipe is taken to Khunjerpur and Myagunge and a 3" pipe will supply water to Barari. From the end of 12" main a 10" and 8" pipes are taken off. The 10" pipe is carried along the District Jail Road and on to the Railway Station to point W. The 8" main is carried along Cleveland Road to point D. marked in map. The above two pipes are connected with a length of 6" pipe and another 7".

From the 10" main a 3" pipe will be taken to supply water to near the Kotwali.

The pipe trenches will all be laid in good firm soil and, as a rule, the pipes will be not less than 3 feet below the surface.

1. The Contractor is responsible for any breakage that may occur in the laying of pipes.

2. The Contractor is to lay the pipes in proper line as directed by the Executive Engineer, or his Subordinate.

3. All pipes before laying are to be thoroughly cleaned. The joints of turned and bored joints are to be cleaned and smoothed and are to be well wetted at the time of jointing.

4. Any joints that are slack are to be run with lead in the usual way.

5. The joints are to be perfectly water-tight; any joints that become leaky from faulty joining within (6) six months of the time of completion of the whole work, will be remedied by the Contractor at his expense. If the leakage occurs in the lead jointed pipes, the pipe is to be jointed again; if in turned and bored pipes, a lead joint will be run in by the Contractor at his expense.

6. The Contractor will not be held responsible for any bursting of the pipes. If any burst takes place the Contractor will put in a new pipe if necessary, and he will be paid at any reasonable rate the Executive Engineer decides.

7. The Contractor is to provide all tools, lead and all other materials that may be required for laying and fixing the pipes.

8. Whilst the trenches are open, and until they are filled in, the Contractor binds himself to put up fences of bamboo or wood, and during the night to suspend lanterns well lit at such places as the Executive Engineer or his Subordinate may point out. The Contractor holds himself responsible for any accidents that may occur to the public through his not having carried out the precautions enumerated, that is, from a want of proper fencing or an insufficiency of lights during the night.

9. Payments for work done are to be disbursed monthly and a deduction of 10 per cent. will be made from all bills, and kept by the Executive Engineer as security for the completion of work.

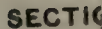
Detail of Estimate for 12" Main.

Length of pipe.	DETAIL.	Number of pipes.	Weight per pipe.	Total weight.	Rate.	Cost.
Ft.			Tons.	Tons.	Rs. A. P.	Rs.
10,603	12" pipes turned and bored socket pipes	587	3433	201.52	102 0 0 per ton	20,555
	12" plain socket pipes	591	3433	202.89	94 0 0 "	19,072
	Earthwork, including filling and ramming, 10,603 x 3 x 3' = 95,427 c. ft.	.....	.....	.....	5 0 0 ,, 1,000	477
	Laying and joining pipes	404.41	..... cwt.	.....	8 0 0 ,, ton	3,235
	T. S. for junction with hydrants	9	2	18	7 0 0 ,, cwt.	126
	Water-posts	9	.....	.....	100 0 0 each	900
	Shut-off valves	3	.....	.....	200 0 0 "	600
	2" W. I. pipes to water-posts	880	.....	.....	0 9 0 per foot	495
	1 1/2" Do. Do.	880	.....	.....	0 6 0 "	330
	Laying and joining 2" pipes	1,760	.....	.....	9 1 0 "	110
	Air-valves and cleaning boxes	2	..... cwt.	..... cwt.	50 0 0	100
	Bends	2	2 each	4	7 0 0	28
	Street services with cattle trough	1	.....	.....	250 0 0	250
	Total of 12" Main	.....	.....	.....	.....	46,278
	Add contingencies	.....	.....	.....	.....	2,314
	G.D. TOTAL	.....	.....	.....	.....	48,592

Detail of Estimate for 10" Main.

Length of Main.	DETAIL.	Number.	Weight per foot.	Total weight.	Rate.	Cost.
Ft.			cwt.		Rs. A. P.	Rs.
7,100	10" plain socket pipes	778	571	202.70	94 0 0 per ton	19,054
	Earthwork, including filling and ramming, 7,100 x 3 x 3' = 63,900 c. ft.	.....	.....	.....	5 0 0 ,, 1,000	320
	Laying and joining pipes	202.7	.....	202.7 cwt.	8 0 0 ,, ton	1,622
	Bends	1	.....	2	7 0 0 ,, cwt.	14
	T. S. for water-post junctions	22	1 1/2 each	33	7 0 0 ,, "	231
	Water-posts	22	.....	.....	50 0 0	1,100
	Shut-off valves	1	.....	.....	150 0 0	150
	Junction with 12" main	1	.....	6	7 0 0 ,, cwt.	42
	2" piping to water-posts	4,440	.....	.....	0 9 0 ,, foot.	2,498
	1 1/2" Do. Do.	500	.....	.....	0 6 0 ,, "	187
	Laying and joining minor piping	4,940	.....	.....	0 1 0 ,, "	309
	Street services with cattle trough, &c.	2	.....	.....	250 0 0	500
	Total of 10" Main	.....	.....	.....	.....	26,027
	Contingencies at 5 per cent.	.....	.....	.....	.....	1,301
	G.D. TOTAL	.....	.....	.....	.....	27,328

DETAIL



PLAN OF CONDUIT G.



PLAN.



Detail of Estimate for 7" Main.

Length of pipe.	DETAIL.	Number.	Weight per foot.	Total weight.	Rate.	Cost.
Ft.					Rs. A. P.	Rs.
	7" plain socket pipes ...	182	362	29'66	94 0 0 per ton	2,788
	Earthwork, including filling and ramming, 1,639' x 3 x 3' = 14,751 c. ft.	.....	.....	.....	5 0 0 ,, 1,000	74
	Laying or joining pipes	29'66	..... cwt.	..... cwt.	8 0 0 ,, ton	237
	T. S. for water-posts	12	1	12	7 0 0	84
	Water-posts	12	.....	.....	50 0 0	600
	Shut-off valves ...	1	.....	.....	75 0 0	75
	Air-valves and cleaning boxes ...	1	.....	.....	50 0 0	50
	Junction with 8" main ...	1	.....	2	7 0 0	14
	Total for 7" main ...	.....	.....	.....	.....	3,922
	Add contingencies at 5 per cent. ...	.....	.....	.....	.....	196
	G.D. TOTAL.	.....	.....	.....	.....	4,118

Detail of Estimate for 6" Main.

Length of pipe.	DETAIL.	Number.	Weight per foot.	Total weight.	Rate.	Cost.
Ft.			Cwt.	Tons.	Rs. A. P.	Rs.
1,509	6" pipes turned and bored joints ...	168	277	20'89	102 0 0 per ton	2,131
	Earthwork, including filling and ramming, 1,509' x 3 x 3' = 13,581 c. ft.	.....	.....	.....	5 0 0 ,, 1,000	68
	Laying and joining pipes	21	..... Cwt.	..... Cwt.	8 0 0 ,, ton	168
	T. junction with water-posts ...	6	1½ each	9	7 0 0	63
	Water-posts	6	.....	.....	50 0 0	300
	Shut-off valves	1	..... Cwt.	.....	65 0 0	65
	Junction with 10" main ...	1	2	2	7 0 0	14
	2" piping to water-posts	1,100	.....	.....	0 9 0 per foot	619
	1½" Do. Do.	1,540	.....	.....	0 6 0 ,,	578
	Laying and fitting minor piping ...	2,640	.....	.....	0 1 0 ,,	165
	Total of 6" main ...	.....	.....	.....	.....	4,171
	Add contingencies at 5 per cent. ...	.....	.....	.....	.....	209
	G.D. TOTAL.	.....	.....	.....	.....	4,380

Detail of Estimate for 3" Pipe.

Length of pipe.	DETAIL.	Number.	Weight per foot.	Total weight.	Rate.	Cost.
Ft.			Cwt.		Rs. A. P.	Rs.
3,198	3" turned and bored socket pipes ...	355	121	19 34	102 0 0 per ton	1,973
	Earthwork, including filling and ramming, 3,198' x 3 x 3' = 28,782 c. ft.	.....	.....	.....	5 0 0 ,, 1,000	144
	Laying and joining pipes ...	19'4	.....	.....	8 0 0 ,, ton	155
	T junctions with water-posts ...	4	2	3	7 0 0	21
	Water-posts	5	.....	.....	50 0 0	450
	Shut-off valves ...	2	.....	.....	40 0 0	80
	Junction with 10" main ...	1	5	5	7 0 0	35
	Junction with 6" main ...	1	3	3	7 0 0	21
	Air valve and cleaning box ...	1	.....	.....	50 0 0	50
	1½" piping ...	660	.....	.....	0 6 0 per foot	248
	Laying and fitting minor piping ...	660	.....	.....	0 1 0 ,,	41
	Total for 3" Main ...	.....	.....	.....	.....	3,218
	Contingencies at 5 per cent. ...	.....	.....	.....	.....	161
	G.D. TOTAL	.....	.....	.....	.....	3,379

General Abstract of Cost.

SUB-HEADS.	Total of each sub-head.	Burari 3" pipe.	Myagunge 4" pipe.	3" Main.	6" Main.	7" Main.	8" Main.	10" Main.	12" Main.	Total
Pipes	Rs. 86,797	Rs. 2,631	Rs. 8,020	Rs. 1,973	Rs. 2,131	Rs. 2,788	Rs. 10,573	Rs. 19,054	Rs. 39,627	46,278
Earthwork	1,996	201	486	144	68	74	226	320	477	2,314
Laying and joining pipes	7,144	216	682	155	168	237	829	1,622	3,235	6,000
T. S.	831	26	91	21	63	84	189	231	126	1,000
Water-posts	5,130	250	650	450	300	600	900	1,100	900	6,000
Shut-off valves	1,300	80	150	80	65	75	100	150	600	495
2" W. I. pipes to water-posts	3,612	375	375	248	578	.....	.....	2,498	330	187
1½" W. I. pipes to water-posts	2,093	.....	.....	.....	165	.....	.....	309	110	.....
Laying and joining 1½" pipes	584	.....	.....	.....	.....	.....	.....	.....	.....	.....
Air-valves ...	167	63	63	41	.....	.....	50	.....	100	28
Bends	350	25	75	50	.....	.....	28	14	.....	.....
Junction with 12" main	133	7	14	.....	.....	.....	.....	42	.....	.....
Ditto 10" do.	56	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ditto 8" do.	49	.....	.....	.....	14	.....	.....	.....	.....	.....
Ditto 6" do.	14	.....	.....	.....	.....	.....	.....	.....	.....	.....
Street services with cattle trough.	21	.....	.....	.....	.....	.....	.....	500	250	.....
Total	1,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
Add contingencies at 5 per cent. ...	1,11,297	3,874	10,662	3,218	4,171	3,922	13,145	26,027	46,278	2,314
GRAND TOTAL	1,16,862	4,008	11,195	3,379	4,380	4,118	13,802	27,328	48,592	.....

Detail of Estimate for 4" Pipe for Myagunge.

Length of pipe.	DETAIL.	Number of pipes.	Weight per pipe.	Total weight.	Rate.	Cost.
Ft.			Cwt.	Tons.	Rs. A. P.	Rs.
10,800	4" pipes socket and spigot Earthwork, including filling and ramming, 10,800' x 3' x 3' = 97,200 cft. ...	1,200	158	85.32	94 0 0 per ton	8,020
	Laying and joining pipes ...	85.32		85.32	8 0 0 ,, ton	682
	Water-posts Shut-off valves ...	13			50 0 0	650
	Air valves ...	3			50 0 0	150
	T. S. for water-posts...	13	1 each	13	7 0 0	91
	1½" piping ...	1,000			0 6 0 per foot	375
	Laying and joining 1½" pipe ...	1,000			0 1 0 ,,	63
	Junction with 12" main ...	1			cwt.	
	Bends ...	8	1 each	8	7 0 0	14
	Total for 4" pipe ...					10,662
	Add contingencies at 5 per cent. ...					533
	G.D. TOTAL					11,195

Detail of Estimate for 3" Pipe for Burari.

Length of pipe.	DETAIL.	Number	Weight per foot.	Total weight.	Rate.	Cost.
Ft.			Cwt.	Cwt.	Rs. A. P.	Rs.
4,450	3" spigot and socket pipe	494	121	26.92	...	...
	Turned and bored ...			12.59	102 0 0	1,284
	Plain socket Earth work, including filling and ramming, 4,450' x 3' x 3' = 40,131 cubic feet...			14.33	94 0 0	1,347
	Laying and joining pipes ...	27			8 0 0	216
	Water-posts Shut-off valves ...	5			50 0 0	250
	Air valves ...	2			40 0 0	80
	T. S. for water-posts	1			25 0 0	25
	1½" piping, 1,000 ft. ...	5	3	3.75	7 0 0	26
	Laying do. ...	1,000			0 6 0 per foot	375
	Bends ...	2	½	1	7 0 0	7
	Total ...					3,874
	Add contingencies at 5 per cent. ...					194
	G.D. TOTAL					4,068

Detail of Estimate for 8" Main.

Ft.		Cwt.	Tons.	Rs. A. P.	Rs.
5,032	8" pipe turned and bored joints ...	560.3	412	103.66	102 0 0 per ton
	Earthwork, including filling and ramming, 5,032 x 3' x 3' = 45,288 c. ft. ...				5 0 0 ,, 1,000
	Laying or joining pipes	103.66			8 0 0 ,, ton
	Bends ...	2 each	4		7 0 0 ,, cwt.
	T. S. for water-posts	18	1½	27	7 0 0
	Water-posts	18			50 0 0
	Shut-off valve	1			100 0 0
	Air-valves and cleaning box ...	1			50 0 0
	Street services with cattle trough, &c.	1			250 0 0
	Total of 8" Main ...				13,145
	Add contingencies at 5 per cent. ...				657
	G.D. TOTAL				13,802

There are two independent horizontal high-pressure engines, with cylinder of 20 inches diameter, 2 feet 6 inches stroke, making 30 strokes per minute, working a horizontal pump for raising the water from the clear water to the surface reservoir. The vertical pump is worked by gearing and is intended to raise the water from the river to the settling tanks. The pumps are double-acting, 13 inches diameter, 2 feet 6 inches stroke, fitted with four double beat valves. The well pump is of the plunger and lift description, having a working barrel of 23 inches diameter, 2 feet 6 inches stroke, making 20 strokes a minute. The maximum speed of the engine is 30 strokes. The 3 boilers are 20 feet, 5 feet 6 inches diameter, made of steel, each one is able to supply necessary steam for one engine. The total cost of the machinery including erection is £4,620.

The engines are working satisfactorily, each engine is able to pump over 50,000 gallons per hour, making 30 revolutions per minute.

Only a portion of the town is supplied with water, as there are no hydrants, etc., at present; also some of the distributory pipes have not been laid.

The Central Jail here gets also a daily supply of 50,000 gallons.

The work was carried out by the following officers:—
D. F. Martin, M. I. C. E., Executive Engineer.
E. R. Gardiner, Assistant Engineer.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK. XXII.

Cement rendering of surface ½" thick over terracing.

Items per 100 s. ft.	No. or quantity.	Rate.	Amount.	Total.
(1)	(2)	(3)	(4)	(5)
Labor.—				
Plasterer No. ...	3			
Coolies " ...	2			
Bhistie " ...	1			
Sundries				
Materials.—				
Portland Cement, lbs. ...	76			
Sand, c. ft. ...	1.7			
Sundries				
Petty Establishment				

Note.—The details for cement pointing correspond almost exactly with those for cement surface rendering, both in respect to labor and materials.

MAIL STEAMERS AND THEIR SPEEDS.

By A. EWBANK.

IV.

THE reader who has thus far followed our exposition of engine action may possibly now be ready to interpose an objection. The objection may be worded somewhat as follows: It appears that with steam working between 150°C and 50°C the theoretical efficiency limit is stated at $\frac{5}{11}$. With steam working between 170°C and 120°C the efficiency limit is reduced to $\frac{5}{14}$, which is less than half of the foregoing. Under these circumstances, it seems useless to employ the latter temperatures when the former give better result towards which the engines may approximate.

Suppose that steam at 120°C enters the cylinder and begins to drive the piston. After a certain supply of steam is in the cylinder the communication with the boiler is closed. The steam thus isolated in the cylinder expands as it drives the piston before it. As it expands, it gets colder. At a certain time it has cooled to, say, 80°C . It then has done a certain amount of work. On continuing to drive the piston and to expand, it further cools, say, to 50°C . It now does additional work. Had the steam been allowed to escape at the temperature 80°C this additional work would have been lost. These remarks will be accepted by the reader as illustrating and enforcing his objection.

The consideration of this objection is apposite to our text, the marine engine, and so we may proceed to consider it. Let us have a locomotive engine with the steam up, *i.e.*, the engine ready to travel.

Let it be standing on rails within a shed, and let it be lifted into the air by ropes from the roof. When it is off the ground, let the steam be turned on slightly. Then a piston will move and its motion will be communicated to a wheel by a set of connecting rods. This wheel is called the driving wheel—which really means the driven wheel. On each side of the engine there is a cylinder, a piston and a driving wheel. Thus two wheels rotate, and the other four (or more) wheels of the engine remain at rest. All that the steam can directly effect is the rotation of the driving wheels. The steam has no power of itself to urge the engine forwards.

While the steam is kept on and the wheels are spinning with some moderate speed, let the engine be gradually lowered till it touches the rails, but let these rails be considered perfectly smooth. Then the driving wheels when they touch the smooth rails will continue to spin—the centres of those wheels remaining at rest. These wheels will thus slip or slide over the rails, and all parts of the circumference of one driving wheel will come in turn to one and the same small part of a rail. The other wheels of the engine will be absolutely at rest, *i.e.*, they will neither move forwards nor rotate.

Let the engine be again lifted into the air. Let the driving wheels be now supplied with a toothed circumference. Let the rails be fitted with corresponding teeth. Let the engine be lowered and let the teeth of a driving wheel fit into the cavities between the teeth of the rail. Then the wheel is thus geared with the rail. The wheel rotating as before by the force of the steam, one of two things must happen. If the engine is prevented from moving forwards the rails will move backwards. If the rails are immovable the engine will move forwards. Under ordinary circumstances the natural rugosities or roughnesses in the wheels and rails supply, as it were, two sets of teeth which interlock and so the engine is driven forwards. We have here given the engine two alternatives—either to drive the rails backward, or be itself driven forward.

Suppose, however, that when the engine was lowered on to the toothed track—and the teeth had interlocked—that the teeth of the track or of the wheel were broken; the force required to break them being less than that required to drive the whole rail backwards, and also less than what is required to drive the engine forwards. Then the wheel would slip without the rail or the engine being moved. Under suitable circumstances we may suppose an engine moving forwards over immovable rails, and

the wheels fairly locking with the roughnesses of the rails. But now let a shower of rain descend. The drops of water in passing through the lower strata of air collect dust and grease and impurities of various kinds. The dirty water then lodges in those little cavities on the rails that constitute the interspaces of the teeth. Likewise the wheels collecting some of this dirty fluid plaister it over their perimeters—jamming it into the cavities. In consequence the teeth no longer interlock as thoroughly as they did before. Then the spinning wheel slips somewhat over the rail surface. That is over one small area of the rail passes more than one small area of the wheel circumference. When this slipping happens the train does not move forwards with as great a velocity as should correspond to the velocity of wheel rotation. Instead of rain we may have snow falling, and this without extraneous dirt can choke up the cavities. The wheels are also liable to slip if the load on the engine is too great, *i.e.*, if there are too many carriages to draw. The wheels are also liable to slip if the engine tries to mount too steep an incline. In the latter case there are two slip-producing causes at work.

Let us again lift our engine off the ground and shut off the steam. Then the wheels will in time come to rest. Let us then, by hand, or other extraneous power, cause a driving wheel to rotate. This wheel will then cause its corresponding piston to move. Here the wheel is really a driving wheel and the piston is the driven body. Neither wheel nor piston can be made to move without the other being compelled through the connections to take up a corresponding movement.

Suppose now that an engine with carriages behind it is travelling at the speed, say, of thirty miles an hour. Let the driver shut off steam. Then in the cylinder there is the last admitted supply of steam driving the piston, and the last-but-one admitted supply is simultaneously escaping into the air. In a very short space of time we shall have the last supply escaping into the air and no fresh steam at work to drive. The engine will now slacken its speed owing to air resistances, friction of axles and other retarding causes. But during the very short time that the piston takes to move one way the diminution of speed will be extremely slight.

The piston moves backward and forward and comes to rest between-whiles. If it was only moved by steam it would not continue to oscillate with almost unabated rapidity when the steam was gone. The piston now moves simply because it is driven by the wheel. Why does the wheel continue to rotate? Partly because it is a heavy body and cannot at once lose its rotatory momentum. But the chief reason is because the engine and carriages make a much heavier body which cannot easily lose their forward momentum. Suppose steam is again put on. There may be an increase of velocity, but during the short time that the piston makes one movement the increase can only be very slight; thus the loss of speed by shutting off steam or the gain of speed by adding or increasing steam is extremely slight when we start, from a time when the steam is in movement at, say, thirty miles an hour, and when we consider only that small part of time in which the piston performs one of its journeys to and fro.

In other words, when the fresh steam is at any time introduced into the cylinder, the speed with which the piston flies before it is very little, due to the pressure of this steam. It is mainly the accumulating result of previous steam supplies. During the very small time that the piston takes to rush from one end of its path to the other end the last-but-one admitted steam must nearly all escape into the air. If it does not it resists the piston's movement. In other words, it is a drag on the engine. Or in other words, it is now undoing the previous good it did.

Suppose now we propose to let steam enter at some high temperature and to expand, doing work, till its temperature is lowered to 50°C . Experiment teaches us that steam of this latter temperature has a very low pressure. In fact, its pressure instead of exceeding

air pressure, is not even one-eighth of the air pressure. Therefore, when the steam has finished its driving work and the passage into the air is opened for it to fly and be gone, it refuses to budge. Not only so, but the outside air—finding a space where the pressure is less than itself possesses—will rush into this space. The cool air rushing in will condense the steam to some extent, so that—instead of the steam disappearing from the engine and turning itself to liquid water, where such a process is not inconvenient—the steam lodges water in the cylinder.

The piston moving in its journey will no doubt by compressing the steam help to drive it out, but meanwhile in doing so it has to exert pressure, and the inrush of cool air has partly cooled the piston. Therefore, when the next hot steam is introduced, this hot steam—finding itself in a cooler place than it would have found had air not rushed in—will to a greater extent be condensed, and so to a greater extent will lose its expansive power. Thus we begin to see that a locomotive carrying for simplicity as few separate parts as possible—and needing to have its piston travelling fast—cannot conveniently deal with steam that is not very hot and that has not a pressure greater than that of the outside air.

We gave our locomotive a range of temperature for its steam between 170° and 120° . These numbers we simply took as an example. Sometimes an engine maker so arranges that the dismissed steam shall at the moment dismissal begins have a pressure not of 2 atmospheres, but of 3 atmospheres. In this case the steam is only cooled to about 134° . The incoming steam may have a pressure of more than 8 atmospheres—say of 10 atmospheres, we are speaking here only of land locomotives. For other engines perhaps higher pressures may be used. In fact, as an experiment a stationary engine has been worked with steam pressure of over 60 atmospheres. Whatever pressure we adopt for the incoming steam in a locomotive, *i.e.*, for the steam as it enters the cylinder, we must have so high a pressure still left to the used steam that it shall be ready to rush with great rapidity into the outside air as soon as a passage is allowed it.

(To be continued.)

A SHORT ACCOUNT OF THE STONE QUARRIES IN THE MIRZAPORE DISTRICT.

BY W. G. BLIGH, EXECUTIVE ENGINEER.

THE Vindyan range of hills form the right boundary of the Gangetic plain for some 40 or 50 miles of its course. In two places, Bindachal (a corruption of Vindichal) just above, and Chunar some 20 miles below, Mirzapore, a rocky spur actually abuts on to the river itself. Between these two places the range of hills is nowhere far distant, and in some parts is within two miles of the bank. The East Indian Railway runs between the river and the hills. The nature of the rock of the Vindyan range here is sandstone, and it is believed to be similar to the new red sandstone of the British isles. This stone is of very superior quality, is easily worked, hard and durable, and is infinitely preferable to the soft sandstone found near Agra and Gwalior. Several varieties of color can be obtained, the principal of which are greyish white, rose color and yellow. The two former are the best, the yellow being deficient in strength and likewise in hardness. In addition to these, on the top of some of the hills a crystalline quartzose variety of stone is found, which is perfectly white, but quarries for building. Stone and slabs of this description are not found within several miles of the river or railway, and consequently its consumption is limited to strictly local requirements. The position of these valuable quarries in close proximity to the old highway of commerce, the Ganges River, causes them to be of peculiar value, and they must have been worked from time immemorial. The remains of very ancient and extensive workings can be seen everywhere, and in some places the hills are composed of nothing but heaps of rubbish, the stone having been all removed to a very considerable depth. The construction of the railway gave a further impetus to the stone trade

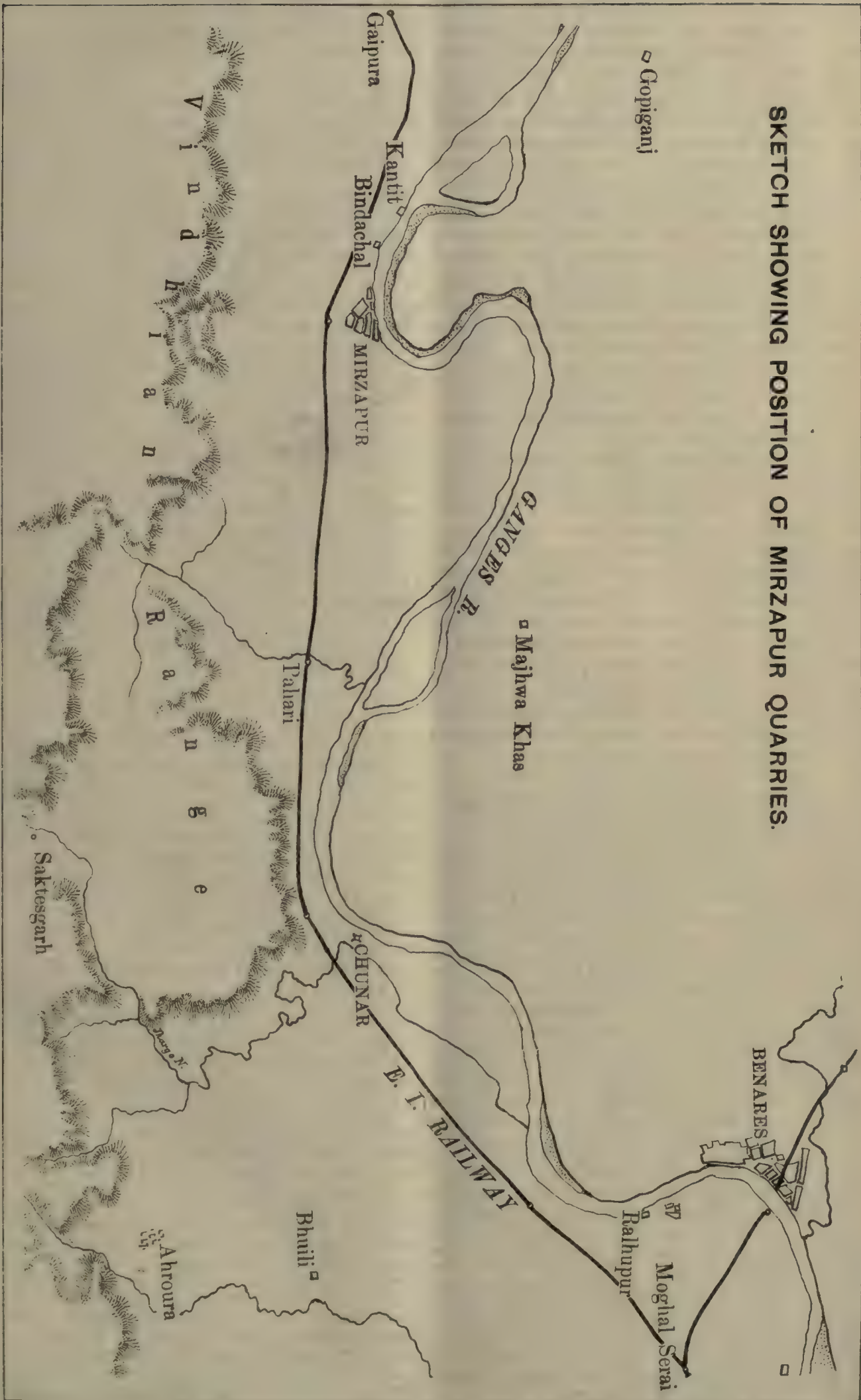
which now assumes very large proportions. As early as 1780, or thereabouts, the then Government of India passed the Stone Quarry Act, whereby the Government reserved its rights to all stone in any part of the Benares Division. The duty brings in a very considerable revenue, and of late years, owing to the representations of Mr. Cadell and Mr. Dale, Collectors of Mirzapore District, a sum of money is granted yearly by the Board of Revenue (generally 10 to 15 thousand rupees) for the maintenance and construction of *pucca* roads leading to the principal quarries. Owing to this judicious policy a perfect net-work of roads have already been made during the last five years, connecting the quarries with the railway stations and the river ghâts at Mirzapore and Bindachal, and by thus largely increasing the facilities of the trade, its certain development will be sure to further enhance the large revenue already derived from the stone duties.

A great deal yet remains to be done in the way of road-making, particularly at Chunar and Pahara, where improvements to the communication, especially to the river, are urgently required. The East Indian Railway have been engaged for some years in relaying their permanent-way, and in lieu of the mixed kunker and brick, which was good enough for wooden sleeper way, finely broken stone is now used, as the old material was not suitable for packing the "D. O." cast-iron chair sleepers now employed. This ballast renewal brought for several years a very large increase of revenue to Government: the stone duty being Rs. 250 per lakh cub. ft. The Company have constructed three ballast quarry sidings, one at Chunar, one at Pahara and a third at Bindachal. There are railway stations at the two first places, but not at the last. The Bindachal quarry supplies ballast up the line, it is believed, as far as Cawnpore. Its position should naturally have been at the nearest accessible point in the Allahabad direction. This happens to be at Gaipura, where an excellent quarry exists within a mile of the existing station. Why this siding was located at Bindachal instead of Gaipura is a question which the lay mind is unable to solve. Possibly the Gaipura hill was never noticed by the Railway Engineers. The Mirzapore stone trade is, in my opinion, capable of considerable extension. I expressed these views in the paper on "New Types of Cheap Roofs." Stone in the shape of flooring or roofing slabs, verandah columns, etc., should be much more used even at places far distant from the quarries than at present. The principal reason why so valuable and permanent material is not more utilized in constructional works is mainly from ignorance of the P. W. Officers and the general public as to the proper price of stone and the cost of its carriage. The European stone firms at Mirzapore make a point of never publishing lists of prices. "Prices on application" is the rule, and there being no "marking in plain figures" the inexperienced purchaser is liable to be charged fancy prices. This policy is most suicidal, and unless it is changed the stone trade will never receive its proper expansion.

The strength of Mirzapore stone, its price and cost of carriage by rail and by boat have already been given in this Journal in the series of "New Types of Cheap Roofs."

Besides the Government and European demand, principally ashlar and slabs, a very large river borne native trade is done. It consists firstly in stone kolhurs, or sugar mills, which are quarried out, roughly dressed to a cylindrical shape, and then rolled down the hillside and along the rough tracks which lead to the river ghâts. They are also sometimes conveyed long distances inland, being dragged by means of ropes fastened on to wooden axles which are fixed temporarily into holes cut for the purpose. Some 30 or 40 men enlivened by barbaric music of shrill pipes and tom-toms drag, push and lever the unwieldy mass along. Often a large kolhu may be seen in perfect order deserted by the roadside for years. The reason is as follows: Going down a slight incline it has got beyond the control of the gang and has run over some unfortunate, crushing him to pulp. The kolhu is then and there abandoned as unlucky and no one will dare to remove it.

SKETCH SHOWING POSITION OF MIRZAPUR QUARRIES.



These stone kolhus are shipped to Azamgarh *via* the Shogra, Benares, Patna, and other places, also going up the Gunti. They are exclusively manufactured at the Chunar Quarries.

Another article of trade is the hand chalcis, which are made in immense numbers and sent all over India, principally down-country. Then square slabs of small size used for some religious purpose, and sillis, or flat slabs for grinding "masāla" on, also flooring slabs of a fixed size obtain a large sale.

The method of quarrying is very simple and consists entirely in the use of wedges. Blasting is seldom resorted to, except for smashing up rock for the purpose of breaking into ballast. The Vindyan sandstone is the most tractable material imaginable and is easily split in any direction. It is likewise, as mentioned before, hard, durable and uniform in quality. The native stone cutters and quarry men are extremely skilful. Mr. Reuss, Agent of the Bengal Stone Company, assured me that he visited some quarries in Germany and found that the methods of working similar stone are in no way superior to what has been practised at Mirzapore for centuries. The use of stone saws for cutting would hardly pay, and it would be a very difficult matter to get the natives to work them. The new quarry roads run close alongside of the hills and the large blocks of stone weighing some tons are levered on to a tilted up country cart, which is then dragged along by eight or less buffaloes. If more than three are required for draught, one or more empty carts are hitched on to the pole of the hinder one. This seems a primitive method, but it answers well in practice. The rubble stone obtained for building is of exceedingly good quality, large, flat, wide pieces being obtained. It can be used with mud mortar and through bond stones are quite unnecessary.

AN APPEAL TO GOVERNMENT IN THE IRRIGATION DEPARTMENT.

BY AN EX-IRRIGATION OFFICER.

I.

THERE are so many distinct ramifications of Civil Engineering science, that no one person can possibly possess more than a superficial knowledge of the whole subject, apart from his own particular line, so that we find that in this, as in the medical profession, there are specialists who devote their attention exclusively to one branch. In India we may enumerate Railways, Docks and Harbours, Roads and Buildings, Water Works, and lastly Irrigation as separate portions of the great whole represented in the Public Works Department. Of all these various divisions of Engineering science the one which is most exclusively and essentially unique is the Irrigation Branch. In this country the largest irrigation works in the world exist, and in no other is the system brought to such a pitch of perfection, if we consider the vastness of the interests involved. When canals were first started, so little was known on the subject, that officers were deputed to visit the comparatively insignificant irrigation works in Italy and Spain, in order to gain information. Now, however, after the experience (often dearly bought) of no less than 40 years, the large works recently carried out in India, can stand as a model, or at least as a valuable guide, to similar constructions in other hot climates. The extension of irrigation operations on a large scale in dry countries, such as California, Mexico and South Africa, is certain to take place with rapid strides, and India, with its vast system of canals, and its unequalled experience in these matters, will naturally be the school of instruction for this comparatively new branch of Engineering and Agricultural science. Already has this been partially the case. Indian Irrigation Officers have now been employed for some years in Egypt, and the application of their experience has borne fruit in very considerable improvements effected in the crude and ill-organized system in vogue in that country. The science and practice of Irrigation is, however, locked up in the limited *personnel* of the Government Department, and the suggestion I am

about to make (with diffidence) is that the Government, who possesses so vast a fund of valuable information and experience, now completely hidden under a bushel, should place the same at the disposal of the world as far as can be effected in a written book. Its object will be twofold; it will form an indispensable record and work of reference for Irrigation Officers in India, and besides this be of incalculable value to the pioneers of flow irrigation in other countries, where knowledge of the details of this important science is *nil*. Many years ago, when perhaps more liberal ideas prevailed on this subject, the Ganges Canal Atlas was published by the Government of the N.-W. P. It was a complete record of Sir Poby Cautley's great work as far as construction went. The original promoters of canal irrigation in India were, however, working more or less in the dark, and we, the later generation, now profit by the errors then made. As regards modern ideas this work is almost quite obsolete, and as a guide would be worse than useless, *viz.*, misleading.

The Ganges Canal Atlas is not mentioned as an example to be followed on the same lines, far from it. What we require is something of much wider scope, not a mere record of any particular work, or series of works, but a comprehensive critical essay in two distinct parts—1st. on the principles and practice of the design of canal works of all kinds; 2ndly, on the principles and practice of the economical distribution of water, with the rules and regulations on the subject.

I do not for a moment suppose that there is anyone who would not admit that this idea, if thoroughly well worked out on the lines given, would prove of immense practical value, not only to the profession in India, but generally, and further that it is incumbent on the Government of this country, which alone possesses the available sources of information, and has a large body of experienced officers at its disposal to undertake it, not only for its own honour and glory, but for the sake of its credit as an enlightened and civilized power. The Public Works Department in India has hitherto signally failed to produce any record of the innumerable interesting Engineering works carried out under its aegis. The Rurki Treatise and the Professional Papers of Indian Engineering are, as far as I know, the only attempts made in this direction. The former, which had for its principal object the instruction of Engineering students in the Government Colleges, is a feeble, casual compilation, in many matters quite obsolete. The latter, a well meaning effort to produce a record of professional works of interest, but which failed from natural causes. These may be enumerated as being mainly due to the absence of inducements to Government Engineers to take the trouble to frame reports of works, and partially to the apathy regarding professional matters, which hangs as a pall over the majority of the members of the Department. But as a matter of fact, no Government in the world is in a better position to supply statistics or valuable information in Engineering subjects than the Indian, and no Government with similar departmental agency has failed so conspicuously in what the general voice of public opinion must echo as its duty to its neighbours in this matter. In England all Civil Engineering is done by private or local means, and consequently a Government publication would be quite out of place. In France and Italy, where the conditions more closely approximate to those that obtain here, we have the well-known "Annales des Ponts et Chaussées," and the "Giornale del Genio Civile," besides numerous other Government Press issues on kindred technical subjects. In Germany and Austria-Hungary the same remarks apply. But in India, where the State Department engrosses the lion's share of the whole Engineering works in that vast country, we find that no attempt is made to place on record, so as to be accessible to the public, any portion of the valuable and unique information on technical matters of worldwide interest that exist, stowed away in musty almirahs, or buried in the brains of departmental officers.

(To be continued.)

FURTHER NOTES ON TABLES FOR ROLLED IRON BEAMS.

BY LALA GANGA RAM, C.E., EXECUTIVE ENGINEER,
P. W. D., PUNJAB.

For any other size of beam not given in these tables, the required number may be found by the following rules:—

(a). Weight and span being the same, safe load varies as the square of depth. *Example*: Supposing there was a beam $9' \times 4' \times 22$ lbs.: required to find the safe load for 20 ft. span. From tables, the number for a section of $8' \times 4' \times 22$ lbs. for a span of 20 ft. is 237; \therefore the same for the given section = $\frac{237 \times 9^2}{8^2} = 300$ nearly.

(b). Depth and span being the same, safe load varies directly as the weight. *Example*: Supposing there was a beam $12' \times 6' \times 50$ lbs., find the safe load for 50 ft. span. In the tables there is a section $12' \times 6' \times 47$ lbs. for which the safe load for 20 ft. span is 960; \therefore for required section safe load = $960 \times \frac{50}{47} = 1,020$ nearly.

G. R.

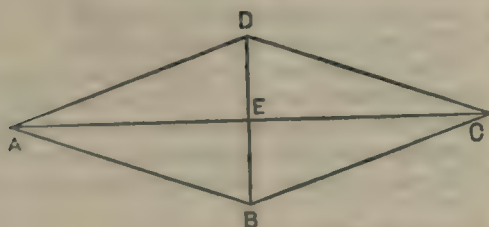
PRINCIPLES OF MECHANICS.

BY A. EWBANK.

VIII.

WE have now proved that for certain angles—in fact for an infinite number of angles—we have the resultant of forces P, P at an angle a equal to $2P \cos \frac{a}{2}$. The student naturally is led to inquire whether this formula does not hold for all values of a when the component forces are equal. Before endeavouring to reply, we may give another form to the question.

Fig. 27.



In *fig. 27* ABCD is a parallelogram all whose sides are equal. Such a parallelogram is sometimes called a rhombus. AC is one diagonal and it bisects the angle DAB which angle we will call a . The other diagonal bisects AC and also cuts it at right angles. Let the length of AB be p inches and of AC be r inches. Then $\cos \frac{a}{2} = \cos EAD = \frac{AE}{AD} = \frac{\frac{1}{2}r}{p}$. Thus $r = 2p \cos \frac{a}{2}$.

That is, the diagonal AC bears to the side of the rhombus the same ratio which the resultant in certain cases bears to one component when the angle a of the rhombus is the angle between the components.

Let a force of P lbs. act at A along AB and let us denote this force by a line AB of p inches. Similarly let P lbs. along AD be denoted by p inches in the side AD. Then if R be the resultant we have $R = 2P \cos \frac{a}{2}$ for certain angles. And in the rhombus $r = 2p \cos \frac{a}{2}$ for all angles.

Then as we have already said R is to P as r is to p . If now we choose $p = P$, that is, if we draw a line p inches to denote a force of P lbs., then the numerical values of r and R become the same.

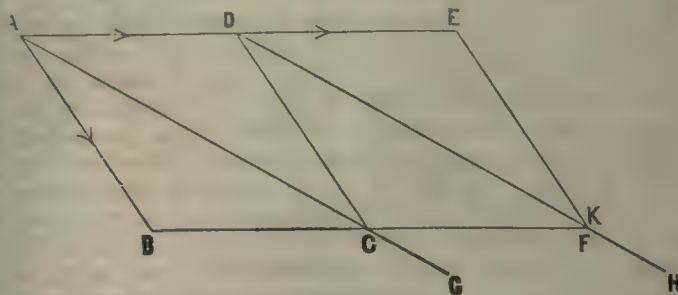
Thus *fig. 27* shews to scale the relations of the component forces to the resultant force. The *fig.* remains true to scale whatever value we take for p . Thus we may have $p = 2P$ or $p = 3P$. Then r becomes $2R$ or $3R$ respectively.

The modified question to which the student may be supposed to expect a reply will now be as follows:—We

know that in certain cases—i.e., for two long series of angles—the length of the diagonal AC of a rhombus may be taken to measure the magnitude of the resultant, when the sides AB, AD of the rhombus measure in magnitude and direction the component forces. Why should not the diagonal always so define the resultant whatever be the magnitude of the angle BAD?

To assert that the diagonal always does so measure the resultant, is to assert the truth of a theorem called “the parallelogram of forces.” This theorem, however, is more general than the case of *fig. 28*. In the general theorem, see *fig. 28* the forces along AB, AD are not necessarily equal.

Fig. 28.



The general theorem is as follows:—

ABCD is any parallelogram, i.e., any four-sided figure whose opposite sides are parallel. Let AB be P inches and let it denote a force of P lbs. acting at A and along AB. Let AD be Q inches and let AD denote a force of Q lbs. acting at A and along AD. Then if R be the number of inches in the line AC, R will also be the number of lbs. in the resultant of P and Q . Moreover, the direction of the resultant will be the line AC.

For the truth of this theorem several proofs have been constructed. One method, perfectly logical, but now out of fashion, is to deduce the parallelogram of forces from another and previously proved mechanical principle called the “principle of the lever.”

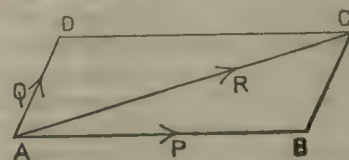
A second proof is known as that of Duchayla and is still used, though it tends also to go out of fashion. For mathematics, like millinery, has its tides of fashion. A third method, lately fashionable, is to deduce the parallelogram of forces from certain laws of motion, which are called Newton's laws.

We may conclude this series of papers by giving a fourth proof. This fourth proof is partly old and partly new. It is old as far as regards the method by which we show that AC in *fig. 28* gives the resultant in direction. It is new in the part where we prove that AC must also give the resultant in magnitude.

Proofs in mathematics are equally good in respect of their logic or rigour. They can only differ in their brevity or in their simplicity or in the light which they incidentally throw on the principles of the science generally. Fashions in mathematics are none of them unreasonable.

Following the method hitherto in these papers pursued we aim less at brevity than at clearness of argument, and at throwing instructive side-lights on the general field of view.

Fig. 29.



In *fig. 29* A, B, C, D, E, F, are points in a body. ABFE is a parallelogram having the side $AE = 2AB$. This parallelogram is divided into two equal parallelograms by the line DC. We will suppose our body to be a thin

slab of stone or wood resting on a horizontal floor. At A, B, &c., we may imagine rings fixed, so that strings may be attached and tensions exerted in any horizontal direction that we please. We are to have a force of P lbs. acting at A and towards B. This force can be exerted by a string. Similarly for all the other forces we may name. At A there is also a force of 2 P lbs. acting towards E.

We commence by changing the force 2 P into a force P acting at A and a force P acting at D towards E. Here we have—to use the ordinary phrase—transferred the point of application of P from A to D. The effect on the body is not altered. The student must reflect on this point if he feels any doubt. We say that if 2 P at A, combined with any system of forces—which we will call the S system—produces equilibrium, i.e., keeps the slab of stone or wood at rest—then P at A and P at D combined with the same S system will still keep the slab at rest. We have left two forces at A, one along AD and one along AB. These are equal. Therefore they may be replaced by some force R—where R is unknown in magnitude but—which certainly acts toward C, because AC bisects the angle A. We have now P at D and R at A. The force R may be removed from A and made to act at C instead. It must of course act along AC produced, i.e., towards G. Here we assert that if 2 P at A acting towards E, and P at A acting towards B should combine with any system T of forces to keep the slab at rest, then P at D acting towards E with R at C acting towards G will combine with the same T system to keep the slab at rest. Having thus twice explained this point, we need not perhaps repeat this explanation.

The force R was originally obtained by combining—or as it is generally called compounding—two forces each equal to P. Therefore it may again be replaced by these P forces. A force R at C acting towards G must thus be equivalent to a force P acting at C towards F and a force P acting at C along DC produced. Thus we now have P at D acting along DE, P at C along CF and P at C along DC produced. Remove this last force up to D keeping of course its direction unchanged. Thus we have P at D along DE, P at D along DC and P at C along CF. Remove this last to F keeping its direction unchanged. Thus we have two forces at D and one force P at F acting towards K. The forces at D may be replaced by a force R. This new force R will be the same as before as regards its magnitude, but it is not altogether equal because this new force acts in a different line. Thus we now have a force P at F along FK and a force R at D which latter force must act towards F because DF bisects the angle CDE. This force R may be removed to F keeping its direction unchanged, i.e., acting towards H. Thus finally we have a force P at F acting along FK and a force R at F acting along FH. These two forces must give a resultant which we will call X. X is indeed unknown both in magnitude and direction. But we do know that the direction must be within the angle HF K. Therefore if 2 P at A along AE and P at A along AB could combine with any system U of forces to keep the slab at rest, then a force X—at present unknown—but acting at F and acting inside the angle KFH—could combine with the same U system to keep the slab at rest.

But the force 2 P at A along AE and P at A along AB must be equivalent to some force Y at A and acting within the angle BAD. Therefore X at F is equivalent to Y at A. Therefore Y at A could be destroyed by reversing the force X at F, i.e., keeping the same line of action, but making X act along it in the opposite direction. For distinction call this reversed force Z. Thus the force Z destroys the force Y. But two forces acting at A and F respectively cannot completely destroy each other's power, unless the line of action of each is a line going through A and through F. If their lines of action are not identical X and Z would make the slab rotate or move. Therefore the line of action of Y, which is a force acting on the body at A, must be the line AF.

We have now proved the parallelogram of forces as regards direction, and in one particular case, viz., the case where one component is exactly double of the other. The angle A between the components may be anything we please. For the force 2 P acting towards E is represented in magnitude and direction by the line AE. The force P acting towards B is similarly represented by the line AB. And we have shewn that the line of action of their resultant is along AF.

(To be continued.)

WELL SINKING BY FREEZING APPARATUS.

IN the last issue of the *Annales Industrielles* we find a very interesting account of shaft sinking and tunnel driving through water bearing sand by means of an entirely novel process invented by a Mr. Poetch of Berlin. This process has been successfully tried in a coal-pit in Belgium, where a 40 feet thick layer of quicksand was excavated at a depth of 230 feet from the surface. The Poetch system consists of sinking through the sand a series of iron or steel tubes about 6 inches diameter, similar to boring tubes, and furnished at their extremities with a cutting edge. At Houssu, Belgium, where the experiment was made, 19 of these tubes were used, spaced in a circle 3 feet apart, forming a circumference of about 20 feet diameter. The tubes were sunk about 6 feet into the coal measure found below the stratum of sand.

This being done, other tubes 3 inches diameter were inserted into the larger ones, and into these a current of liquid cooled to a very low temperature was passed, which descending by the inner tube rose again to the surface in the outer annular space between two tubes.

The liquid generally employed was chloride of magnesium cooled by the expansion of ammoniac.

The first trials made at Houssu were not satisfactory, because the machine employed for refrigerating the liquid was not sufficiently powerful, producing only 6 or 7 degrees of frost. But on the employment of machines capable of producing a temperature of 15 or 25 below freezing point, the soil for a distance of 20 feet on each side of the tubes commenced to congeal rapidly. Once the sand was well frozen the shaft was excavated out, as in hard rock.

This done, the cylindrical shaft lining formed of cast iron sections of a thickness of 40 millimeters was set up, the foundation being laid at a depth of 6 feet below the surface of the solid coal, that is, as far as the tubes penetrated.

The frozen sand presented all the appearance of very hard rock. The chloride of magnesium injected at 14°C. lost only 2 degrees of cold in its transmission through the pipes.

Another application of Poetch's freezing process was made in the construction of a tunnel passing under a portion of the city of Stockholm, where the least movement would endanger whole streets of houses. In addition to this the tunnel traversed a very bad water bearing stratum. The method of procedure here differed from the former. The tunnel casing having been well closed behind M. Poetch placed a shield 3 feet in advance of this wall, and caused atmospheric air, cooled to a temperature of 50°C., to be conveyed into the chamber thus formed. In 24 hours' time the soil for a depth of 10 feet in every direction was frozen hard. The shield was then advanced 7 feet and the masonry casing carried on. After which the process was repeated.

W. G. B.

THE cost of planting an acre with the Eucalyptus amounts to £20, about 1,600 trees going to the acre of nursery ground. After planting out, it is probable that at the end of twenty years 600 trees will have survived worth 8s. a piece.

It is reported that the earth's heat is being used in a practical way at Pesh, where an artesian well is being sunk to supply hot water for public baths and other purposes. A depth of 8,120 feet has already been reached, and this well, supposed to be deeper than any previously existing, supplies daily 176,000 gallons of water heated to 150° Fah.

MINING IN GREAT BRITAIN.

(From our own Correspondent.)

THE Belgian Sheet Iron Masters' Association has addressed a most important circular to 83 English, 6 Welsh and 9 Scotch makers of sheet iron. They point out that owing to the perfect union and mutual confidence prevailing between the Belgian manufacturers, considerable advantages have been derived from the adoption of uniform prices. The object of their communication is to introduce in all foreign countries a similar understanding as to prices. There is great difference of opinion expressed by British makers in respect to the practicability of the proposal, but it is generally understood that there is no prospect of material advantage resulting to this country from such a syndicate.

There appears to be some possibility of the Westphalian Coal Trade Syndicate being formed. The special features of the proposed arrangements are:—To operate for five years from 1st January 1888; and each member to entrust the Company with the sale of all the coal produced by him at a fixed price for the whole 5 years; the Company is also to have power to reduce the production of its members, whenever they consider the state of trade demands such a limitation.

A syndicate for the sale of the produce of the Prague coal-field in Bohemia, has been in operation since 1869. The sale of the whole of the coal is in the hands of the syndicate, which operates over the whole of Bohemia by means of a large number of resident and travelling agents.

As this Company has existed since 1869, it is highly probable that its operations have been carried on to the satisfaction and profit of its members.

Considerable interest is being taken in a valuable paper by Mr. Kayser (Manager of the Mount Bischoff Tin Mines in Tasmania) on "Automatic tin-ore dressing." He condemns the present systems of dressing tin-ore, and more especially the stamping of it, through fine grates. He advocates stamping of the poor ore, and the crushing and jigging of the better qualities. This system, which has been successful abroad, at least merits a fair trial in this country.

Some valuable figures are given in a recent issue of the *Mining and Scientific News* (San Francisco, U. S.) shewing the profitable working of a mine with gold ore valued at about 4s. 8d. per ton. The following is the record for one month, at the Spanish mine, Washington Township, Nevada County.

Mine.—22 days' work produced 2,796 tons of ore.

Cost of production	Labour.	Stores, &c.	Total.
	\$	\$	\$
Extracting ore	486.59	85.73	572.32
Dead work	237.30	43	280.30
Delivering ore to mill	126	10.70	136.70
General expenses	58.22	3.30	61.52
Totals	908.11	142.73	1,050.84
Cost per ton	0.324	0.051	0.375

Mill.—20 days' work reduced 2,796 tons of ore.

Cost of reduction	Labour	Stores, &c.	Total.
	\$	\$	\$
Mill expenses	163.45	143.10	306.55
Water for power	.....	152.20	152.20
Handling ore	121.50	2.96	124.46
General expenses	58.23	3.30	61.53
Totals	343.18	301.56	644.74
Cost per ton	0.123	0.107	0.230

Bullion produced	...	\$ 3,268.49
Total expenses	{ ... Mining ... \$ 1,050.84 ... Milling 644.74	\$ 1,695.58
Profit	...	\$ 1,572.91

It will astonish many Mining Engineers to be informed that gold-ore worth about 4s. 8d. per ton can be worked so as to leave a clear profit of 2s. 3d. per ton. The deposit of ore is large and cheaply worked, neither pumping or winding being required, as it is quarried out of the side of a hill and run by cars direct to the mill. The vein is about 100 feet wide, and the ore is a mixture of slate and quartz. The mill contains four Huntingdon mills, driven by water power; after crushing the pulp passes over silver-plated amalgamating plates, but most of the gold is saved in the mills. It will be noted that the four-roller mills crushed 2,796 tons of ore in 20 working days, which requires the advocates of stamps to look to their laurels.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Mysore, January 14, 1888.

With reference to Notification, dated 24th December 1887, Mr. C. M. Anandathirtha Rao, Assistant Engineer, is posted to the Ashtagram Channel Division. To join at once.

Burma, January 14, 1888.

Notification, dated the 22nd December 1887, granting Lieutenant W. R. Morton, R.E., Assistant Engineer, 1st grade, attached to the Public Works Secretariat, 14 days' privilege leave from the 2nd January 1888, is hereby cancelled.

Madras, January 17, 1888.

Mr. C. W. Wood, Assistant Engineer, 2nd grade, is declared to have passed on the 5th January 1888 the Professional Examination prescribed in the Public Works Code.

Punjab, January 19, 1888.

His Honor the Lieutenant-Governor is pleased to sanction the promotion of Mr. E. S. Farrant from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from the 28th March 1887, to fill an existing vacancy.

Irrigation Branch.

With reference to Government of India, Public Works Department, Notification, dated 19th October 1887, Mr. F. C. Rose, Assistant Engineer, 2nd grade, landed at Calcutta on the 20th November 1887, and joined the Chenab Canal Division, to which he had been posted, on the afternoon of the 30th November 1887.

Mr. C. Tickell, Executive Engineer, 3rd grade, from the Swat River Canal Division, which he left on the forenoon of the 16th December 1887, to the office of Joint Secretary, which he joined on the forenoon of the 23rd idem.

Mr. C. Tickell was attached to the office of the Joint Secretary on special duty from the 23rd December 1887 to the 31st December 1887, both dates inclusive.

With the approval of His Honor the Lieutenant-Governor Mr. C. Tickell, Executive Engineer, 3rd grade, is appointed Under-Secretary to Government, Punjab, Public Works Department, Irrigation Branch. He assumed charge of that office from Mr. Sidney Preston on the afternoon of the 31st December 1887.

With reference to Punjab Government, Irrigation Branch, Notification, dated 28th July 1886, and Memorandum, dated 9th September 1886, Mr. R. Sadler, Executive Engineer, 3rd grade, landed at Bombay, on return from 16 months' leave on Medical Certificate granted to him by the Secretary of State, on the 5th December 1887, and was posted on special duty to the Swat River Canal Division, which he joined on the forenoon of the 11th December 1887. Mr. Sadler took over Executive charge of the Swat River Canal Division from Mr. C. Tickell, Executive Engineer, on the forenoon of the 16th December 1887.

India, January 21, 1888.

Colonel A. LeMessurier, C.I.E., R.E., Chief Engineer, 3rd class, sub. *pro tem.*, is, on return from furlough, placed on special duty, with effect from the 19th December 1887.

The services of Mr. A. S. Gerrard, Executive Engineer, 2nd grade, sub. *pro tem.*, State Railways, are placed temporarily at the disposal of the Government of Bombay.

This cancels Public Works Department Notification, dated 30th November 1887.

Mr. P. L. A. Price, Assistant Engineer, 1st grade, Punjab, having been absent for more than five years, is, under section 142 of the Civil Leave Code, struck off the list of the Engineer Establishment of the Public Works Department.

Mr. H. L. Monk, Executive Engineer, 1st grade, State Railways, is granted special leave for two years, under the terms of Public Works Department, dated 3rd October 1887, with effect from the 1st February 1888, or any subsequent date on which he may be able to avail himself of the same.

In Public Works Department Notification dated 9th January 1888, granting Major Sedgwick, R.E., special leave after "days" add under the terms of Public Works Department Nos. 1940-41 G., dated 3rd October, 1887.

With reference to Public Works Department Notification dated the 30th December 1886, Mr. W. H. Chase reverted to his substantive rank in class III. of the Superior Revenue Establishment of State Railways, Locomotive Department, with effect from the 1st April 1887.

The Governor-General in Council is pleased to order the following promotions to and in the classes of Chief and Superintending Engineers, with effect from the dates specified:—

Colonel C. H. Luard, R.E., Chief Engineer, 2nd class, to be Chief Engineer, 1st class, permanent, with effect from 15th November 1887.

Colonel J. M. McNeil, R.E., Chief Engineer, 3rd class, to be Chief Engineer, 2nd class, permanent, with effect from 15th November 1887.

Lieutenant-Colonel F. J. Home, R.E., Superintending Engineer, 1st class, sub. *pro tem.*, and Chief Engineer, 3rd class, temporary rank, to be Superintending Engineer, 1st class, permanent, with effect from 9th November 1887.

Colonel E. Swetenham, S.C., Superintending Engineer, 1st class, temporary rank, to be Superintending Engineer, 1st class, sub. *pro tem.*, with effect from 9th November 1887.

W. D. Brockman, Superintending Engineer, 2nd class, sub. *pro tem.*, to be Superintending Engineer, 2nd class, permanent, with effect from 9th November 1887.

Major W. P. Tomkins, R.E., Superintending Engineer, 3rd class, to be Superintending Engineer, 2nd class, sub. *pro tem.*, with effect from 9th November 1887.

Baluchistan.

Mr. W. H. Rushton, Assistant Engineer, 1st grade, is appointed to hold charge of the 2nd Division, Frontier Road, during the absence on deputation and privilege leave of Mr. O. Hoernle, Executive Engineer, 3rd grade, or until further orders.

Director-General of Railways.

Mr. A. Bewley, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India an extension of four months' furlough in continuation of the twenty months granted him in Director-General of Railways' Notification, dated 17th September 1886.

Lalla Rala Ram, Assistant Engineer, 3rd grade, is transferred, in the interests of the public service, from the North-Western Railway to the Office of the Director-General of Railways.

Bengal, January 25, 1888.

Establishment.

Mr. C. P. Warde made over charge of the Hazaribagh Division to Mr. W. B. Christie on the forenoon of the 11th instant.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 19th January 1888.

- 17 of '87.—Charles Moseley, of the City of Manchester, England, Manufacturer.—*For improvements in, and apparatus for, the manufacture of cards such as are used in the preparation of fibrous materials.*
- 153 of '87.—John Joseph Reveley Humes, of 18, Lilford Road, Camberwell, in the County of Surrey, England, Engineer.—*For improvements in, or applicable to, motor engines operated by the combustion of fluid hydrocarbon.*
- 154 of '87.—Ernest Manbré, of Garston, in the County of Lancaster, in the Kingdom of England, Brewer.—*For improvements in, or appertaining to, compounds applicable for the manufacture therefrom of ale, stout, porter, lager and other like liquors, and in apparatus for making said compounds.*
- 174 of '87.—Herbert Augustine Bamford, Assistant Inspector of European Schools, Bengal, residing at No. 1, Theatre Road, in the town of Calcutta.—*For an improved Pankah specially adapted to confined spaces and capable of being worked either vertically or horizontally.*
- 230 of '87.—Charles Langdon Davies, of 110, Cannon Street, in the City of London, England, Electrician.—*For apparatus for the employment of vibratory electricity in telegraphy.*
- 245 of '87.—Francis Louis Julian Guyon, of No. 7, Lyons' Range, in the Town of Calcutta, Broker, and Philibert Bonvillain, at present residing at the Hotel de Paris, in Dhurumtollah Street, in Calcutta, aforesaid, Engineer.—*For a compound hydraulic press for pressing in bales or otherwise jute or other fibrous material and texture of every description.*
- 247 of '87.—Arthur Andrews, Merchant, of No. 3, Elysium Row, in the Town of Calcutta.—*For improvements in the metal package suitable for the packing, storage and carrying of tea and other substances of a like nature, known as "Andrews' Patent Metal Tea-chest."*

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(Sd) RANCHORELAL CHOTALAL,

PRESIDENT OF THE AHMEDABAD MUNICIPALITY,

14th January 1888.

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F. L. CHARLES,

Actg. Munipl. Commr. for the City of Bombay.

Municipl. Commr.'s Office, Bombay, Jan. 19, 1888.

NOTICE.

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EDITORIAL ANNOUNCEMENTS.

AN Index of the contents of Volume II. with a title page will be issued at an early date this month.

Contributors would doubly favor us by having any drawings or sketches that may accompany their articles prepared of a size to suit the pages or columns of the Journal.

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Obituary.

LEE.—At Bombay, on 19th January, Charles Lee, C.E., late Engineer and Secretary, Hyderabad Municipality, aged 55 years.

ANSWERS TO CORRESPONDENTS.

"SUB.," "F. R. U.," "W. G. BLIGH," "MADGE."—In our next.

INDIAN ENGINEERING.

SATURDAY, FEBRUARY 4, 1888.

GOLD-MINING IN SOUTHERN INDIA.

A MR. OGDEN, who proclaims himself a mining specialist, has sent us a pamphlet he has written on the auriferous rocks of the Wynaad, Nilgiri, and Mysore gold-fields. He writes with an excursive shew of argument, which it is difficult to piece together into any likeness to cohesion; but as far as we have been able to make out the drift it is a plea for economical working, and a protest against the employment of Cornishmen on Indian mining operations. Economy is of course a grand word to conjure with. The only question that need be asked about it is—What does it mean? It must be remembered, Mr. Ogden writes, that "we are now after gold, not tin, and that the native mechanic and miner for rupees thirty will undoubtedly carry out more work than the mechanical engineer for rupees three hundred per month." That is possible of course, but without skilled, scientifically informed direction what is the use in a mine of so many square feet, or so many square yards, filled with purposeless, haphazard drifting human labor power? Your Indian miner left to his own devices, whether he is in quest of rubies in Burma, diamonds in the Punnah State, or gold in Southern India, works always on the crude, superficial, unsystematized methods, lackings of method, it would be more absolutely correct to say, that were rules of thumb with his ancestors thousands of years ago. He can find in himself no affinities to scientific mining; he dislikes and resents anything of the sort in fact, just as he does any imputation on any of his cherished conservatisms, any alteration in habitudes that have grown to be, in their way, a religion to him. He must be supervised, captained, made to work on the lines his captain's superior knowledge enable him to lay down. Without such supervision and guidance, gold-mining in India can no more be expected to pay in 1888, than it did in the year 88 or the year 888, after such auriferous strata as lay near the surface had been exhausted.

Mr. Ogden delights in teaching; all rocks, he tells us, "with their component parts, have been undergoing for ages past a change." With reference to Mysore gold-fields he writes:—"I maintain that before investing much capital in such a claim a very careful Geological investigation must be completed." He warns the public to be on its guard against flowery reports which in many instances terminate in disaster. By way of counterpoise to which warning he has "no doubt that with economy the mines will pay." He would like to be all things to all men, we take it. The Chiknayakanhalli band is mentioned as worth prospecting. In that connection our pamphleteer remarks:—"To these imperfectly crystalline schists therefore we must look for success, the deeper the synclines the longer the mines will last, it may be argued by some, that when the basement of the upper group is reached we can then drive north and south (presuming this to be the 'strike'

of the lode) and take out the lode to the full extent of our north and south boundaries, and that the supply of stone can last for years. But as payable gold in the Mysore gold-fields occurs for the most part in 'Shoots' or 'Pay Chimneys' the chances are that north and south of these 'Shoots' in the lodes, the quartz will be poor, then greater economy must be exercised to make the mines pay, it is almost upon the richness of the shoots which it is hoped will last out many a year, and the depth of the upper series of 'Auriferous rocks' that the English shareholders and the Mysore Government have to look, for the latter, in order that her revenues may be increased as far as the royalty upon the outturn of gold is concerned."

Less than 100 years ago, Mr. Ogden informs us, he had the pleasure of managing a Southern Indian Mining Company, in an old gneiss formation, which Company's affairs in the course of his management "assumed a bluish tinge, and went into liquidation." The moral he deduces therefrom seems to be that by far the most important of the auriferous rocks "lie in Synclinal folds in the gneiss," and are first cousins to the "Archæan."

Enough of an unsuccessful and splenetic babbler. Turning to mining enterprise at large, we have to remark that most contradictory accounts from time to time reach us as to the issues and prospects of gold-mining operations in Southern India. We should like to get hold of, one of these fine days when fates are propitious, we hope, and mean, to get hold of, more searching and trustworthy information on the subject than is as yet available to the public. Mingling companies make a great, a suicidal mistake in withholding from the public information about the progress and aptitudes of their affairs. As the *Madras Times* says pertinently: "Of course by preventing European visitors, or members of the Press, from visiting at leisure and thoroughly examining all that is going on, may be very useful to the employed, when buying and selling shares in their own companies, but it is not a good policy." We feel no hesitation in stigmatizing it as a very rotten policy. Whatever private interests it may subserve, they are what Mr. Ogden, *à propos* of auriferous strata, calls "outliers." They cannot be commended on any common-sense politico-economic grounds; and it follows as a matter of course that they fail to attract investors, or to command public sympathy on any grounds whatsoever.

Companies, mining or miscellaneous, that court the sympathy of the public, that are dependent on public support for existence, must do such work as they set themselves the doing of *coram populo*. If their work is worth doing, and well done, and successful, therefore, they will find their advantage in parading before the public and therewithal storming its confidence, such premia on endeavour as from a dividend producing point of view they have been able to secure. If dividends, profitable results, elude them, are beyond their power, and only available rhetorically, then their empty pronouncements will have to go to the limbo provided by a pitiful fate for inutile egoism, and such pretentious trash as Mr. Ogden has put forth in his tract. All well wishers to mining interests in Southern India—in which good company INDIAN ENGINEERING is proud to claim a place—must, with us,

regret that a good cause should be fooled around, prevented, and hindered by such a damaging advocate as the disappointed, vain-glorious ex-Manager of Southern Indian Mines, whose diatribe has furnished occasion for this writing. On page 7 of his *brochure* it is written:—"The mercury has got 'SICK' and wont amalgamate with the precious metal." Mr. Ogden's excavations in vain-glorious strata of diseased inner consciousness won't amalgamate with anything precious; but may do some harm to the cause he professes to have at heart. And that would be a pity, and worse.

We should very much like to see published a succinct, truth telling review of the present condition and prospects of Southern Indian gold mines—a plain unvarnished tale. We incline to belief in the potentialities of the mines; but in the hands of irresponsible scribblers facts get so intermixed with rubbish that it is more than difficult to arrive at anything like a fair estimate of what is and what may be.

MYSORE WATER-SUPPLY.

THE city of Mysore is to be congratulated on the successful solution of the difficult and important problem as to its water-supply. From the peculiar circumstances of its position this necessary of existence has been the universal cry of the inhabitants, upon which they depend for their health and comfort. Ever since the foundation of the city it has suffered from the want of pure water, which has gone on increasing with the increase of population. A good deal of Engineering skill has been brought to bear on the subject from time to time, and with the growing needs of the people, but with very little appreciable results. It is a matter of history that even during the *régime* of previous Maharajas, efforts were made to introduce a system of water-supply, but notwithstanding the expenditure of fabulous amounts, or to put it in milder terms, large sums of money, all attempts ended in failure. Old Mysoreans need hardly be reminded that in years gone by, the great Poorneah, Dewan of Mysore, left not a stone unturned to direct the course of the Cauvery into the town. How the attempt failed, and how the deep ditch he excavated for the purpose exists to this day as a memento of haphazard attempts at trifling with Engineering projects, need not be recapitulated here. Suffice it to say that with the advance of Western civilization several other projects were put forward and partly executed with scarcely happier results. Although Mysore has won the honor in the race with Bangalore for an efficient supply of pure water, it must not be forgotten that the first-mentioned town possesses facilities which are denied to the latter. In the case of Mysore there are reservoirs which more than answer the requirements of the people if properly utilized. The greatest storage of water is in the Kukerkhali tank, and it has now been conclusively proved that this tank can be readily filled in years of ordinary rainfall. Let him who merits bear the palm. The credit of the scheme belongs to Mr. Standish Lee, the Sanitary Engineer, and the cost is estimated at Rs. 1,26,300. The plan has been accepted after much deliberation. The facts are that about two

years ago, Mr. Lee had submitted four alternative proposals or alternative estimates for the distribution of water from the Kukerkhali tank, but no action was taken thereon as "it was considered premature to deal with the question until an actual assurance was obtained that the reservoir itself would receive in ordinary years a supply to warrant a large outlay on a permanent system of distribution." About the middle of September last it was found to contain 45 millions of cubic feet of water, sufficient for the requirements of the whole for the next eight months, at the rate of 20 gallons per head per diem, or 13 gallons for the whole twelve months. Since that time the supply has been considerably augmented. Colonel Bowen therefore considered himself justified in recommending Mr. Lee's scheme, and in submitting it for sanction observed :—

"It is true the rainfall of the year has been exceptionally good ; but when it is kept in mind that the Sankarhundi tank was not tapped until the 11th September, and that the extension scheme contemplates tapping also the Yemanhalli Valley, thereby adding 4,500 acres to the catchment basin, I have no doubt whatever that we may now safely count on the reservoir receiving an ample supply even in years of scanty rainfall."

The scheme includes dip-wells for Brahmins and Sivayets, bathing tanks for females, patent filtering fountains and playing fountains. The Dewan went carefully through the whole proposal, and without interfering with the main features of the scheme, he has cut down the number of dip-wells and fountains, and entrusts the management of "exclusive" fountains to the Deputy Commissioner and the Municipal Board of Mysore. The filtering fountains will be placed in the most conspicuous parts of the town, so as to be accessible to all. It is evident that the Dewan is no admirer of æsthetics when not combined with usefulness, for he has struck out "Playing fountains" from the list of constructions and has sanctioned hydrants to be used in cases of fire. It should here be observed that owing to its peculiar position the city of Mysore is divided into high level and low level districts, of which the former is to be supplied from cisterns and the latter direct from the main. As the western part of the city cannot derive any benefit by any of the above methods, special arrangements will have to be made for meeting its wants. With reference to the supply of water at a higher level than the present sluice the Dewan observes :—

"It should be easy, I think, to utilize the force of water passing through the sluice to raise the small quantity required for the higher level. Two or three Hydraulic Rams such as the one now used under Sankey's Reservoir at Bangalore, or a Turbine, or both Rams and Turbine could be easily worked in this way. The water can thus be lifted to a cistern near the new Public Offices, and thence utilized for the Public Office and its grounds as well as for distribution to the western extension and to the upper story of the Palace. The cost would be moderate, and as a higher water-rate for the use of this water would be willingly paid, we should get a handsome return on the capital outlay. This scheme should be carefully worked out and dealt with by a supplemental estimate."

THE INDO-EUROPEAN TELEGRAPH DEPARTMENT.

MODERN scepticism as to the truth of matters it cannot taste, or handle, finds compensations for its self-esteem and faculty for certitude in statistics. They are very bumptious, and it is refreshing to come across instances of their fallibility. One such instance the Administration Report of the Indo-European Telegraph Department for the year 1886-87 affords us, for, *à propos* of fluctuating revenue we are told of "a large write-back from maintenance on account of stores erroneously charged to it in a previous year." That is a fault on the right side of the statistical record. That an error in book-keeping should have been made in no wise injuriously reflects on the Telegraph Department. Its work is scientific and utile ; not clerical. At the same time the men who conduct it must be able to work economically. No department unable to do that can justify its existence now-a-days. No department ought to suffer under the stigma of an unjust reproach. *Ergo* our protest against the too common habit of a blind acceptance of statistics as *ex-officio* gospel truth.

The figuring of the Resolution before us shews the working expenses of the year under review to have amounted to £86,552. The net revenue was £13,827. This is a distinctly satisfactory result, provided that there is nothing "erroneously charged" and that no "write-back," large or small, is casting a sour shadow on departmental ledgers. We note that charges for establishment and repairs are departmentally admitted to be high. Under such adverse conditions as the Indo-European Telegraph Department has to contend with maintenance of an efficient ordering of affairs, and due regard for public interests, must needs cost more to keep up than does the maintenance of lines that run their whole length through more civilized, accommodating, and practically minded stretches of the world's bye-ways. It is a mistake to suppose that economy can be measured always by a standard of rupees, annas, and pice.

The truest economy is efficiency. That, we are glad to believe, has been maintained, in a manner worthy of the Department's reputation, although what we are pleased to call the collapse of the Afghan Boundary Commission was it seems pecuniarily detrimental to departmental interests. Possibly the world at large was a gainer from the absence of reports as to mere talkee-talkee. Possibly when Russian troops are *in situ* at Peshawar and Lahore, Anglo-Indian Governments will arrive at some comprehension of Russia's real objects and endeavours ; and then—well then, we suppose, gentlemen connected with the Telegraph Department in India will have to assimilate their conduct of life to Tartar ideals of propriety. Meanwhile, it is proper to mention that the working of the Indo-European telegraphic route, during the official year 1886-87, was far from blame-worthy. There was no total interruption at all in the Gulf Section between Bushire and Kurrachee. The sum total of interruptions between Bushire and Teheran only mounted up to 2½ days in the aggregate, the longest of them being for one day, fourteen hours, and

twenty-two minutes in January 1887. On the Indo-European Company's Section between Teheran and London the gross total interruptions were for 4 days, 17 hours, and 11 minutes, the longest individual interruption having been 2 days, 18 hours, and 45 minutes in December 1886. That is such a long while ago that we can judiciously afford to forget all about it, in consideration of subsequently uninterrupted well-doing. The working speed on the Teheran route between England and Calcutta averaged one hour and thirty-one minutes, during the year under review—an improvement on the time register of previous years. The proportion of errors detected in telegraphic messages was higher during the year under review than in the previous one.

There was also marked decrease in the number of complaints made by the public. The report makes no reference to cause and effect in this connection; but the co-relation between the two agencies is sufficiently obvious. Paragraph 8 of the Resolution we do not profess to be able to understand. It is thus worded:—"The amount of traffic transferred between the Eastern Telegraph Company's lines, and those of the Teheran route was exceptionally small, owing to the freedom of both systems from serious interruptions." The italics are ours. Paragraph 9 is melancholically suggestive. This is its message to the public:—"On the 1st July 1886 the tariff between India and the United Kingdom was reduced from francs 5.60 to francs 5 a word, or from 4 shillings and 7 pence to 4 shillings, as levied in the United Kingdom. The continued fall in exchange has however prevented the Indian public from deriving any appreciable advantage from the reduction." Is there any wickedness that this ill-advised uncommercial rupee of our times is unwilling to abet? It affects prejudicially the financial position of all Government departments, and hinders that development of the resources of the country that is a virtuously canonical "did ought" with all legitimately constituted minds. It cripples trade, it afflicts people with moderate incomes, who have to send money home for their children's education, or their wives' bonnets and board and lodging bills. The only way by means of which its iniquities can be in any sort discounted and guarded against lies through the Indo-European Telegraph Department. Let us be properly grateful therefore for the kindly ministrations of its officers; and let us hope that they will learn how to keep accounts. Meanwhile, we may perhaps be allowed to suggest that the amount of valuable, or should we say invaluable, service rendered to the public, as well as to Government, by officers of the Indo-European Telegraph Department, can be realized only by journalists who have learnt of sad experience the length and breadth of inefficiency attaching to Reuter's diletante and tardy selections from Home News, for the use of the Indian Press.

Many officers attached to the Indian Telegraph Department have deserved commendation for their work and its outcomes. No man has approved himself more worthy of such tribute of respect than Sir J. U. Bateman-Champain, K.C.M.G., who died last year at San Remo. In the *Gazette of India* of the 14th January

1888 it is written "His death deprived the Government of India of an officer whose practical good sense, sound judgment, and unfailing tact, combined with a thorough knowledge of the whole system of international telegraphy, had often proved of great value to the interests of India. For sixteen years this officer was the Director-in-Chief of the Indo-European Telegraph Department.

The total expenditure of cable during the year under review amounted to 213½ knots, of which 99.1 knots were used in renewing that length in the Bushire Fâo cable. 17.67 knots were used in Kurrachee harbor to connect the sea shore batteries with the military station. The section of the new cable which was laid in 1885 on a 1 fathom shoal was removed into deeper water. On the Mekran coast land line 253 new creosoted pine posts were erected in the Gwadur division. In the cable factory at Manora 89.5 knots of cable were manufactured, 87.73 knots repaired and retaped, and 71.93 knots stripped, preparatory to the serviceable parts of the core being re-made into cable.

Under the heading "Traffic" it is written in the supplement to the *Gazette of India* on which we are making comment:—

The Regulations and Tariffs of the London Convention were in force during the first three months of the year, when they were superseded by the revision of Berlin, which came into operation on 1st July. The chief alteration in the Regulations was the exclusion of rectifying messages from the international accounts. The necessity for this exclusion was so great that this modification had, by agreement with India, been adopted *via* Teheran and Suez towards the end of the previous year, or a few months before the new rule became conventionally applicable. The principal modification in tariffs was a reduction on the extra-European lines, bringing the tariff between Europe and India down to Fcs. 5 *via* Teheran or Suez, and Fcs. 4.50 *via* Turkey. Reduced rates for Press messages generally between England on one side and India and Australia on the other, were also brought into operation from 1st July.

The average speed of transmission by each of the three routes from England to Calcutta, according to the *Government Gazette*, was, *vid*—

Teheran.		Turkey.		Suez.	
H.	M.	H.	M.	H.	M.
1	31	13	23	2	31
In 1885-86 it was	3 42	13 52	3 36		

Compared with the previous year there was, therefore, a very great improvement in the speed from England to Calcutta *via* Teheran.

The author of the Report we have been considering and criticising, writes:—"The Persian Government have shown a most friendly spirit in allowing us to retain the superintendence and working of the Teheran Meshed line. Nothing could more clearly illustrate the change in their feelings from distrust to confidence which the 24 years' work of our telegraph staff in Persia has effected." One of the most to be commended characteristics about this staff is that it knows when to leave off. So do we.

Notes and Comments.

ROAD-MAKING EXTRAORDINARY.—We learn that a party of Pioneers from Meerut, and two guns of the Royal Artillery from Jellapahar start for Sikkim to repair the road leading through that country to Thibet by way of the Jelapla pass.

THE BENGAL P. W. D. SECRETARYSHIP.—It is rumored that Colonel J. P. Steel, R.E., Chief Engineer, Nagpore, C. P., stands as good a chance as any one for the coming vacancy to be occasioned by the retirement of Colonel, C. M. Browne, R.E.

SATISFACTORY SETTLEMENT?—The demarcation of the Afghan Boundary to the Oxus is finished, the last pillars having been built on the 19th January. Colonel Yate and the boundary party hope, if permitted, to return by the Trans-Caspian Railway.

NAVAL DOCKYARDS IN EASTERN WATERS.—The new Admiralty Dock, the largest in the Far East, was opened on the 9th January to receive a Chinese ironclad of 7,000 tons. The finishing touches have not yet been put to the work, and until this is done no formal opening ceremony will take place.

THE DIRECTOR OF PUBLIC WORKS, CEYLON.—Mr. MacBride has returned from home. Mr. R. D. Ormsby, who has been acting for the Director during his absence on leave, has applied for and obtained leave for six months. Mr. Ormsby has done excellently well in Mr. MacBride's chair, and we hope that great things are yet in store for him.

HEALTHY COMPETITION!—At the half-yearly meeting of the East Indian Railway Company, Mr. Crawford, the Chairman, said that their relations with the North-Western (State) Railway were harmonious; but that was not the case with regard to the Bombay and Baroda and the Rajputana Railways, the conductors of which "seem to employ the whole of their time in pilfering traffic" from the E. I. R. Company.

ANOTHER LIGHT RAILWAY.—A scheme of railway extension which, it is calculated, will lead to an important development of the forest resources of the Canara district, is in contemplation. Preliminary surveys have been commenced during the past few days for a railway through the heart of the Canara forests, which is intended to give an easy access to the market for the forest wealth of that part of the Presidency.

BURRAKUR IRON WORKS.—We hear that a "Company" at home is proposing to take over this concern from Government, the capital for the purpose being readily forthcoming. Representatives of the "Company" will visit Burrakur next month with the view of making a definite proposal to Government. It is satisfactory to learn that the quality of the outturn of the ironworks has conduced largely to this offer.

COAL PROSPECTS IN ASSAM.—The Coal Mines of Lakhimpur, which were leased some years ago to the Assam Railways and Trading Company, seem at length to be in a way to answer the expectations once formed of their resources. Last year at any rate the exports of coal from Assam rose from 91,707 maunds to 2,59,000 maunds. No word yet, however, of the petroleum lying untouched in Assam being properly exploited.

PUBLIC WORKS IN GWALIOR.—Of the twenty lakhs of rupees allotted by the Gwalior Durbar for expenditure by the Public Works Department during the year 1886-87, not even five lakhs have been expended up to date

Mr. Harris, the Superintending Engineer, finds either some difficulty in securing the services of efficient men or is unwilling to push on with the most important projects, sanctioned at Gwalior, Ujjain, and other places.

ANOTHER LARGE MASONRY BRIDGE IN SOUTH INDIA.—Government have sanctioned an estimate amounting to Rs. 1,66,100 for constructing a masonry bridge of 16 arches of 60 feet span across Ponnai River on the road to Pondicherry. The proposed bridge is to replace the old bridge, which was destroyed during the heavy floods of 1884. We may discuss the grounds on which it has been decided to build a masonry bridge in preference to an iron bridge hereafter.

BOMBAY PORT TRUST.—Nearly 23 lakhs of rupees were expended on the Dock Extension works in 1886-87. The total amount spent on these works up to the close of the year was about 41½ lakhs of rupees, the sanctioned estimate being nearly 94 lakhs of rupees, of which 50 lakhs were advanced by Government during the year. Good progress was made with the work connected with the Dock Extension scheme. The question of providing a dry dock for merchant ships is not lost sight of.

FORESTS OF WESTERN INDIA.—The three Forest Circles were worked with very different results during the year 1886-87. In the Northern Circle of the Presidency an expenditure of about 7 lakhs of rupees brought in a revenue of a little over 9 lakhs. The Thana forests are the most valuable in the Circle. In the Southern Circle the same expenditure produced a revenue of 14½ lakhs. This Circle contains the virgin forests of Kanara. In the Sind Circle an expenditure of 5½ lakhs brought in a revenue of nearly 7 lakhs.

PRINCE'S DOCK EXTENSION WORKS, BOMBAY PORT TRUST.—Progress Report No. 36, for December 1887, shews that the excavation of the Dock was completed with the exception of 400 brass remaining to be removed from the incline. Certificate No. 35 for Rs. 37,141-9-1 was passed, making the total amount paid to the contractors to date Rs. 39,34,033-11-5. The daily average number of men and women working on the Dock and at the quarries for Messrs. Kirby & Co. was 2,108, the greatest number in one day (8th) being 2,651.

RAILWAY MISMANAGEMENT IN BURMA.—A local paper says that it is too much, perhaps, to expect a department, which, after eleven years' experience, is unable to supply a sufficient number of timber trucks, at a station 40 miles distant from Rangoon, to have sufficiently enlarged views on the subject of the requirements of the additional 240 miles between Toungoo and Mandalay. We think it as well, though, thus early to draw the attention of the Local Government to the matter, for it should be taken in hand at once, or very grave public inconvenience will be felt when the Mandalay extension is opened.

NAINI TAL WIRE-ROPEWAY.—A scheme is in contemplation for conveying goods by a wire-rope way from Kathgodam to Naini Tal and *vice versa*. A work of this kind is urgently required, the cost of which will be about two lakhs. A careful calculation shews that the profit must be over 12 per cent. on the capital. An experimental wire-rope way, carrying loads weighing 50 pounds, is on view at Edge Hill, and can be seen on application. Messrs. Burn and Co., of Calcutta, consider that the 9 miles of line from Kathgodam to Naini Tal should be erected for Rs. 20,000 per mile.

H. H. THE NIZAM'S IRRIGATION BOARD.—It is recorded that the officers employed as District Engineers in

Telingana districts should be sufficiently qualified to give assistance in irrigation matters. If it is found advisable to employ District Engineers on irrigation matters, the Chief Engineer and Secretary, P. W. D., can submit a statement at the end of the year shewing the share of pay of the District Engineer and his establishment debitable to the Irrigation Board and the Government in the P. W. D. will be asked to procure the services of two new Engineers for whom Rs. 900 per mensem have been provided in the Budget of the Board.

RAILWAY EXTENSION IN THE PUNJAB.—Now that the arrangements for commencing the construction of the Patiala State Railway to Bhatinda have been put in train, the survey for the long-talked-of Sutlej Valley line is also to be vigorously taken up. The proposal is to commence with the point where the Patiala line is to terminate at Bhatinda, and proceeding thence by Abohar and Minchinabad, link in with the North-Western system at Bahawalpur—a distance of about 200 miles. Survey parties are to take the field at once, the whole being under the direction of Mr. Parker, the Superintending Engineer in charge of the Patiala Railway.

RAILROAD IN MASSOWAH.—The Italian Government has advertised for bids for rolling-stock, bridges, etc., for the proposed railroad from Massowah on the Red Sea Coast, inland, which will be constructed under the supervision of, and with funds provided from, the Italian War Department. The gauge of this line is one metre. For the present the following will be required: six closed and six open freight cars, 12 passenger cars of the third-class, two passenger cars of various classes, tanks for the transportation of water, three steel bridges, and 18 iron bridges having a span of from 8 to 10 yards. The motive power will consist, in the beginning, of only one locomotive.

SURVEY OF THE HOOGHLY.—The *Englishman* gave strong expression the other day to the necessity for a survey of the upper portion of the Hooghly, similar to that which Captain Petley has already furnished for the lower portion. The paper now says:—"We are glad to learn that a thorough survey above Calcutta has already been started, and that a careful cross-section of the river has been made as far up as Chandernagore, fully delineating the bed of the river and foreshores. We understand that a small staff of surveyors will continue the work next March if they can be spared from the lower reaches, and, as we have already observed, the importance of such a survey cannot be over-rated."

SIR ANDREW CLARKE'S MISSION TO SIAM.—A NEW RAILWAY PROJECT.—Sir Andrew Clarke is on a mission to Siam. He represents a syndicate of English merchants who are endeavouring to secure from the King sanction for a line of railway to open up South-Western China, from Bangkok *via* the valleys of the Meinam and Meikon rivers, which it is believed, is a far preferable route to that proposed by Mr. Colquhoun from Moulmein, where every pound of freight would have to be raised and lowered 24,000 feet. The French in Tonquin are known to contemplate a railway with a similar object along the valley of the Red River. Sir Andrew Clarke has been selected, as he is well known to the King and his advisers.

RAILWAY EXTENSION IN OUDH.—A railway is talked of between some point past Azimgurh (the difficulty is to find a point where the Ganges can be bridged easily) passing through Azimgurh, Pertabgurh, Rae Bareilly and joining the Cawnpore branch at Haroowni. Another line is not exactly being surveyed, but what Engineers call

being "looked at" (whatever that may be) between Baraitch and Khyrabad on the Sitapur line, with perhaps an extension to a place little known, called Nimkhar on the banks of the Gumti. Nimkhar is rather a holy place, where a sleek and well-fed community thrive on the offerings of pilgrims, who throw money into a tank which is occasionally drained and the money deposited taken out and divided.

THE KIDDERPUR DOCK WORKS.—During the past three months considerable progress has been made, work being pushed on vigorously. The total expenditure up to the end of the quarter was Rs. 71,10,286, of which Rs. 49,12,493 were on account of works, and Rs. 21,97,793 for land. The health of the work people continued to be satisfactory. The average number employed was 7,816, and the death-rate only 17.5 per thousand. Arrangements have now been made for laying a line of rail along the boat canal bank, and so connecting the Dock works and the Akra brick-fields with the Eastern Bengal State Railway system, thereby relieving the block in the traffic on the existing river side line and its extension to Akra.

INDIAN COAST DEFENCES.—Lord Brassey, who lately returned from a cruise, which was chiefly devoted to taking notes of the defences of the large maritime cities of the British Empire in India and the Colonies, gave the result of his observations in a recent lecture at the London Chamber of Commerce. Lord Brassey commended the defences at present existing and in course of erection, at Bombay, and the efficiency of the dockyard, but advised the employment of additional monitors, and the organization of crews to form a harbor defence flotilla, as Bombay, he considered, should be the chief naval station in the East. His Lordship strongly urged the formation of local batteries of Artillery, and the raising of regiments of militia at Colombo and Singapore.

THE MOULMEIN-YUNNAN RAILWAY.—Lieutenant G. J. Younghusband, of the Corps of Guides, having been over a good portion of the proposed line of a railway from Moulmein *via* Rahang across the Northern districts of Siam and thence, through the Eastern Shan States to Yunnan and Western China, warns investors that if they think they are likely to get any interest on their capital (in other words, that this line will pay them) they are likely to be greatly mistaken; to humanitarians he would say: "By all means open up, and civilise these nations by the aid of your railway." But to speculators his advice would be: "Keep your money in your pockets, or else, if you must invest it in railways, invest it in the extension of the railway system of India and Burma."

THE HYDERABAD-PACHPADRA RAILWAY.—Public opinion in Sindh is still intent on the construction of this line being forthwith commenced. Dr. Pollen, C.S., has examined the whole line of country between Oomercote and the confines of the Jodhpore State, through which the projected railway has to pass, and has publicly avowed that the surmises of the Government of India as to the impracticability of its construction are quite incorrect. This difficulty having been disposed of, it is now maintained by the same advocate as a further argument against the fears entertained by the P. W. D. of the line not proving remunerative, that the land revenue would be materially increased by the assessment being raised owing to additional facilities for transport.

SANITATION IN THE BOMBAY PRESIDENCY.—The outlay on military sanitary works during the year 1886-87

amounted to Rs. 2,48,433. A large part of this sum was spent in Bombay, where bungalows for officers in the Marine Lines were constructed. Something was also done to make the Ghorpuri barracks at Poona more healthy. The amount expended by district Municipalities on conservancy during the year amounted to Rs. 3,38,763. The water-supply of Municipal towns is derived from rivers, tanks and wells. In Sindh, canal-water is frequently used for drinking purposes. The water-supply of Broach and Surat was insufficient. That of Ahmednagar was likely to fall short in times of drought. Poona and Kurrachee had a very good water-supply. That of Ratnagiri and Satara was fair.

MANUFACTURES IN WESTERN INDIA DURING 1886-87.—The Bombay Administration Report for last year says that no new factories were opened during the year. The total number of factories to which Act XV. of 1881 applied was 110. The Goolam Baba Mill at Surat, which was burnt down in 1885, was reopened with new machinery. The number of cotton mills in the city of Bombay was 50, and in the Mofussil 20. The year 1886 was a good one for local cotton manufacturers. China and Japan proved better customers than in previous years, and there was a brisk local demand for home-made goods. Steamer freights to China were cheaper owing to competition among the steamship companies, and Port Trust charges were reduced. An agency was established at Aden to develop the Somali Coast and Red Sea Ports trade.

THE KHATTAN OIL-FIELDS.—Four wells have been sunk, two of which are 500 feet deep, and from all four a fairly plentiful supply of thick black oil is being pumped. This oil is of the consistency of treacle, and although unfit for illuminating purposes, it is nevertheless very valuable, as it has been tried with perfect success for firing locomotive boilers as a substitute for coal and wood. It was only hoped that a sufficient supply of oil would be obtained to work the Sibi-Quetta section of the North-Western Railway; but the results of the borings now shew that the whole of the North-Western Railway can be supplied. The great question now is how the oil can be best transferred to the railway. The nearest railway station to Khattan is Baber Kach, some 30 miles north of Sibi on the Sind-Pishin Railway.

MYSORE EXTENSIONS, S. M. R.—A Correspondent, writing to us under date the 23rd January, says:—I have very little in the way of news to communicate. Work is progressing very slowly, labor is scarce, and the rates do not admit of importing the necessary men. Mysore is very backward in the way of skilled labor; we get men who can hardly use a pickaxe, and as for jumpers they hardly know what they are. The "Wudders" are the only earthwork class of laborers and they are a drunken, idle set of loafers, working about three days in a week. In some of the subdivisions masonry has been started, but "no orders" is the rule all through. We are hampered in rates and delayed in obtaining sanction for everything but earthwork; only that and a part of the masonry has so far been sanctioned, and yet the Government require the line in eighteen months from date of starting, eight of which have already gone by.

SURVEY OF STEAMSHIPS.—With the previous sanction of the Governor-General in Council, the Lieutenant-Governor of Bengal has been pleased to issue new rules for the survey of steamships. From these we glean that the

Surveyors will be guided by the rules issued by the Board of Trade in so far as such rules are applicable to surveys made in India. In cases where two surveyors are employed, the Engineer-Surveyor will survey the engines, boilers and all the machinery required to be surveyed under the Act. The Shipwright-Surveyor will inspect the hull, equipments and passenger accommodation, measure and determine the number of passengers the vessel is fit to carry, and see that the certificates of the master, mates, and engineers or engine-driver are such as is required by the Act; also that the lights and fog signals are in accordance with the regulations for the prevention of collisions at sea.

BENGAL CENTRAL RAILWAY.—The report of the Directors, adopted at the meeting of shareholders states that the total charge to capital for the 125.19 miles of line to 30th June is £759,823, or £6,069 per mile. The gross receipts were £22,720, a decrease of £733. The expenses were £25,112—an increase of £1,196. The loss on working during the half-year was £2,391, compared with £462 for the corresponding half of the previous year. The working expenses have been increased by the larger payments to the E. B. S. Railway for working the line under the revised agreement; and the maintenance charge is still abnormally high, owing to charges for the repairs of the flood damages which will shortly be completed. If the abnormal expenditure on flood works be excluded from the expenses, the half-year's working would shew a profit. Since the close of the half-year the traffic has continued to improve, and up to the 12th November there was an increase of Rs. 53,338.

BOMBAY UNIVERSITY.—For the *First Examination in Civil Engineering* there were 44 candidates from Poona College of Science, of whom 17 passed the examination. 1 was placed in the first-class and 2 were placed in the second-class. 13 were Hindus, 1 an Indo-European, 1 a Parsi, and 2 Portuguese. In 1886 there were 47 candidates, of whom 31 passed. In 1885 there were 23 candidates, of whom 14 passed the examination. For the *Examination for the Degree of L.C.E.* there were 15 candidates from Poona College of Science, 10 of whom passed the examination. 2 were placed in the first-class and 4 in the second-class. 9 were Hindus and 1 a European. In selected subjects 5 passed in Analytical Geometry and Differential and Integral Calculus, 3 in Mining and Metallurgy, 1 in Mechanical Engineering, and 1 in Botany and Meteorology. In 1886 there were 20 candidates, all of whom passed the examination. In 1885 there were 20 candidates, of whom 13 passed the examination.

OUR RANGOON ITEMS.—The capital and revenue accounts of the Burma State Railway for the half-year ending 30th June 1887, shew a decrease of nearly Rs. 4,000 in working expenses, though the train mileage has increased during that half-year. In the Insein Workshop of the Burma State Railway, there are 30 Karen apprentices undergoing a mechanical training, and as some of them have volunteered to learn the work of drivers, Mr. Dugson, the Locomotive Superintendent, has recommended that during the last two years of their apprenticeship they be trained as firemen and shunters. This will eventually obviate the necessity of importing native drivers from India. Great disappointment is felt among the officers and subordinates of the P. W. D. who were employed and rendered good services during the campaign in Upper Burma at being left out in the cold *re* the

Burma Honors List, while officers and subordinates of the Military Department got brevet rank, extra warrant rank, &c. Why have the P. W. D. men been overlooked?

THE QUESTION OF TRAINING LEAVE TO YOUNG ENGINEERS.—A Resolution of the P. W. Department states that the experiment of sending young Engineers, domiciled Europeans or natives, to England at the public expense for professional training, has not resulted well; the three local Governments consulted were of opinion that the value of the training was not commensurate with the expense incurred. The experiment has extended over five years. Notwithstanding this, the Government of India thinks that training in England is an undoubted advantage to those officers who have a real desire to profit by it, but that the expense of it ought to be largely contributed by the officers themselves. Accordingly, Government will pay officers absent from duty in India two-thirds of their salary, together with an allowance of one thousand rupees to assist in defraying the cost of passage. It is also proposed to send not more than two officers annually on these modified terms. The age for officers this year is limited to 30 years, next year 28, and thereafter 25.

LEAVE RULES TO WARRANT OFFICERS.—The following are some anomalies which require rectification:—A Sub-Conductor of the Public Works Department, holding the rank of Sub-Engineer, taking furlough out of India under the rules of 1868 draws half Staff and full Military pay. An officer of the same rank, taking furlough under the rules of 1875 draws £60 per annum, all told. The pay of a Sub-Conductor in the Public Works Department, 1st grade Sub-Engineer is Rs. 400; according to the rules of 1875 he would draw half that amount, *viz.*, Rs. 200, while the one under 1875 would draw about Rs. 60 per mensem. Which of the two is the most liberal. A man has to be 20 years in the service before he can get the warrant rank. Nevertheless a Sergeant is better off under the articles. A Sergeant holding the rank of Sub-Engineer 1st grade going home on furlough draws full Sergeant's pay, which is more than the net pay of a Warrant Officer and his staff (civil pay); half a Sergeant's pay is about Rs. 60 clear; his civil pay Rs. 340, half 340 = 170, plus 60 = 230.

A COMPLICATION.—The Directors of the East Indian Railway Company having referred to the legal advisers of the Company a matter in which they were in difference with the Government, with reference to the charge for income-tax made upon the Company in India. The opinion obtained was that the Company was not a Company within the definition contained in the Income Tax Act, and that the Government were not entitled to call upon them to make any return of their profits; also, that if the surplus profits were liable to taxation at all, the Government were not entitled to assess the whole of the Company's share of the surplus profits to the tax, and deduct the same *en bloc* from the moneys payable by the Secretary of State to the Company, but that, in that case, the deferred annuity holders would be liable individually. But the Secretary of State in Council still holding that the Company is liable to Indian income-tax, the Company exercised the right to call for arbitration in the matter, as provided in the contract. Thus the matter stands at present.

THE OLD QUESTION.—A Calcutta paper is of opinion that the Government of India have acted wisely in endeavoring to eliminate the Royal Engineers from roads

and buildings, irrigation and accounts, and consider that if there should be any surplus Royal Engineers available after supplying all military requirements, the most suitable sphere for their employment would be on the construction and management of railways, as the experience gained on such work would be valuable in time of war. When, however, it uses the term "management," it does not do so in its widest sense, and considers that young Royal Engineers should be trained in the Traffic and Locomotive Departments (especially in the details of traffic management), so as to enable them to work a line in an enemy's country. Up to date, however, of all the Royal Engineers who have entered the Public Works Department, not a single one has entered either the one or the other; though many have sought and succeeded in obtaining the coveted and comfortable appointment of "General manager."

ARCHITECTURAL COMPETITIONS IN N. S. W., AUSTRALIA.—The Premier has invited competitive designs for the State-house and Mausoleum which it is proposed to erect in the Centennial Park. Sir Henry Parkes made two mistakes. He indicated a style of building which could scarcely be built for five times the amount authorised by Parliament, and he offered as a prize to the successful competitor a sum that would scarcely pay for the preparation of the plans. The building must necessarily be erected on a large scale. It is to contain, as defined in the Act which authorises its construction, a great hall or amphitheatre, a museum, a gallery for the reception of statues and pictures, and a public mausoleum. It is intimated to competitors that the building must be monumental in style, and the architecture, "Classic and Corinthian." The materials to be used are, "externally, granite, copper, bronze, &c., and internally, marble with mosaic and stained-glass decorations." No wood or iron is to be used in the construction of the building. The successful competitor would not be allowed to carry out the work, which would be done in the colonial architect's office, and his design and plans would become the property of the Government.

PROTECTION WORKS ON THE E. B. S. R.—Ever since the construction of the above line, the portion between Aranghata and Kissengunge stations at 51 and 65 miles, respectively, has been liable to more or less heavy floods during the rains. The several disastrous floods which occurred during the time of the E. B. R. Company first opened their eyes to the necessity of providing suitable openings in the line for the safe passage of the floods, and accordingly two bridges, each of 10 spans of 35 feet, were put in by them between 61 and 62 miles. The experience of the last floods, however, which occurred in September 1885, shewed that additional flood openings were needed for the safety of the line, inasmuch as a great gap measuring about 640 feet long by 200 feet broad and 30 feet deep was caused at 59 miles, besides several smaller breaches in the embankment and failures of minor bridges and culverts. The water on this occasion rose as high as rail level at several places, and the difference of head between the west and east sides of the embankment was as much as 5 feet. Three additional bridges have therefore been decided upon, two of 10 spans of 40 feet at 57 and 59 miles, and one of 5 spans of 40 feet at 54 miles. These flood bridges were taken in hand about two months ago, and are now in full swing. Messrs. K. L. Mookerjee and Co., of the Jubilee Bridge, are the Contractors, and Mr. T. B. Byers, Sub-Engineer, in charge of works.

Current News.

THE Irrigation Committee on the Sone Canals has completed its enquiries, and is now preparing its report.

LIEUTENANTS E. L. DUNSTERVILLE and E. P. Johnstone, R.E., have been brought on the Indian Establishment.

THE recent heavy fall of snow in Quetta has had the effect of breaching the Bolan Railway between Abigum and Mach.

THE Bashahr Forests, situated in the valleys of the Pabar, Rupin and Giri rivers, have been retransferred to the control of the Punjab.

MR. J. W. Alexander, at present attached to the Office of Superintending Engineer of this circle, is now on special duty for a month at Lucknow.

ANOTHER half-company of Sappers and Miners is to be despatched from Roorkee to Kaloodanda for employment on the new works at that station.

COLONEL FILGATE, Accountant-General in the Public Works, takes furlough at the commencement of the rains, and afterwards retires from the service.

DURING the year 1886-87 the jute crop in Bengal was larger than in the year preceding, but despite this fact the average price per maund shewed a rise of a little over 11½ per cent.

INSTRUCTIONS have been issued for the rolling-stock of the Cud-dapah-Nellore State Railway, now in course of construction at Nellore, being at once handed over to the South Indian Railway.

THE appointment of the Chief Director of the Indo-European Telegraph, held by the late Sir John Bateman Champain, will come under the reduction, and be incorporated with the Indian Telegraph Department.

ESTIMATES, amounting to Rs. 13,800, for constructing an iron lattice girder bridge and two buckle plate bridges over the Teki drain near Gangavaram, in the Godavari district, have been sanctioned by Government.

COLONEL A. LEMESSURIER, C.I.E., R.E., Chief Engineer, 3rd class, sub. *pro tem.*, Consulting Engineer to the Government of Mysore, is, on return from furlough *vid Merve*, placed on special duty, with effect from the 19th ultimo.

COLONEL LUARD, R.E., Consulting Engineer for Railways, who is now on furlough, has obtained an extension of ten months. Colonel LeMessurier, who has lately returned from Central Asia, will probably officiate.

THE very severe snowstorm, lasting 30 hours, began at Quetta on the evening of the 23rd. The entire country from Harnai to the Khwaja-Amran Range was covered. This is the heaviest fall within the memory of the oldest inhabitants.

A RETURN of accidents on Indian Railways during the second quarter of 1887 shows that, as compared with the corresponding quarter of the previous year, the number of accidents to trains, rolling-stock, permanent-way, &c., increased by 97, or 10·74 per cent.

A TELEGRAM from Darjeeling reports that it is snowing there hard. Heavy snow has also fallen recently at Simla. According to a telegram some five feet have fallen in the last four days and the fall still continues. The fall extends from Murree to Mussoorie.

THE report of the Deputy Sanitary Commissioner on the Municipal towns of the Vizagapatam district, shews that the insanitary state of the district is as bad as it ever was. Government has directed that a complete scheme of drainage be prepared for the town of Vizagapatam.

IN view to the speedy completion of the reconstruction of the Pennar, Papugni and Chittravuthy bridges on the North-West line of the Madras Railway, three professional Bridge Inspectors have been entertained at Rs. 250 per mensem with the authority of Government.

GENERAL AENEAS PERKINS, R.E., Secretary to Government in the P. W. D., Punjab, and Mr. E. E. Oliver, Under-Secretary, arrived at Dehra Ghazi Khan on the 23rd December and are now marching along the new road under construction, from there across the Suliman, towards Pishin. Colonel Harvey, R.E., has also joined them.

IT is rumored at Lucknow that the building known as the Khorshaid Munzil has been selected for the coming High Court. It is one of the *muzzool* (escheated) houses. It was the mess-house of the 32nd (Queen's) during the Mutiny. Just in front is the spot where the meeting between Lord Clyde and General Havelock took place.

A FATAL railway accident occurred on the Northern Bengal State Railway on the 26th ultimo, twelve miles from Sara. A goods train left the track while crossing a bridge, and was partially wrecked. A permanent-way man was killed, and another dangerously wounded; the others made rather lucky escapes. An inquiry into the casualty is to be instituted.

ON arrival in India, Lieutenant G. M. Heath, R.E., is, with the concurrence of Government, posted to the Bengal Sappers and Miners. Lieutenant C. H. Cowie, R.E., is transferred from the Mooltan Defence Division to the Rawal Pindie Division, Military Works. Lieutenant Joly, R.E., has been transferred from the

Umballa Division, Military Works, to the Karachi Defence Division.

LARGE numbers of laborers—some five or six thousand—mostly Hazaras and Ghilzais, have collected near the Khojak Pass to work on the military road and the Khwaja-Amran Railway extension. A Pioneer regiment may be employed on the work in the spring. The Political Agent in Pishin started on the 24th instant to go to the Khojak, but he was stopped by a heavy snow-storm and severe weather.

A CORRESPONDENT says:—"We learn from a confidential source that the Honorable Raja Peary Mohun Mukerji, C.S.I., of Uterparah, has applied to the Government of India for granting him a concession to construct steam tramway, on the Old Benares Road, from Howrah *vid* Jonai to Sheakhala. The application has been made on the ground, that the Honorable Raja has been all along one of the chief promoters of the proposed line in question."

IN consequence of Colonel J. M. McNeill, R.E., Chief Engineer and Joint Secretary to the Government of Bengal, having taken a year's special leave, Lieutenant-Colonel C. W. J. Harrison, R.E., will continue to act for him in both appointments. As Colonel Harrison is not yet a permanent Superintending Engineer, 1st class, he is to be congratulated on his good fortune in continuing to hold a temporary Chief Engineership for so long a time.

THE annual report of the Telegraph Department for 1886-87 shews that the gross revenue was nearly sixty lakhs of rupees, thus exceeding the average of the previous three years by some thirteen lakhs. The net revenue was 18½ lakhs, exceeding the corresponding average by 8½ lakhs. This is the largest revenue ever collected. The working expenditure aggregated over 41 lakhs or nearly 5 lakhs in excess of the average. This increase, as would be imagined, is almost entirely due to the new lines in Upper Burma.

THE Rilli River, where the 32nd Pioneers are about to build a bridge, is only some twenty miles by road from Lingtu, where the Tibetans have established their fortified post. Hence the necessity of employing troops on the work. The Tibetan post is said to consist of a long wall sixteen feet high and eight feet thick with bastions at each end, and quarters for the men holding it. It completely blocks the road, and is very strong. It runs from the summit of the hill to a precipice which borders the road, and can only be turned therefore at one extremity.

WE have already stated that Government had decided to widen and effect other improvements to the Elephant Gate Bridge, Madras. An estimate of Rs. 20,200 has been sanctioned and a commencement of the work has already been made by the erection of dams across the river. The work is being executed by the Public Works Department. It is to be hoped that it will be completed as early as practicable, as the obstruction to wheel traffic, at the present time, causes immense inconvenience to the public in general, and merchants in particular.

WE are glad to see that the supporters of the Dehra Dun Railway project have not lost heart, and intend setting about the business in a more direct manner than has hitherto been attempted. If the Railway will pay so well as has been argued, it is obviously waste of time urging a reluctant Public Works Department to take it up. On the other hand, if Mr. C. W. Hope should find it possible, as we believe it is his intention to attempt, to float a company at home, the laugh—should the estimated profits come in—will be on the side of the enthusiasts, and one more be added to the long list of good enterprises which Sir T. C. Hope left severely alone.

SOME correspondence recently passed between Government and the Engineering Department regarding the erection of a line of telephonic communication between the Cauvery and Vennar regulators and the Superintending Engineer's office at Trichinopoly. The Engineering Department considered that a means of rapid communication between the places named above, was very desirable, in order that the Superintending Engineer may be able to give orders regarding the quantity of water to be admitted into the Cauvery and Vennar rivers. Government has now sanctioned the setting up of a line of telephonic communication between the Cauvery and Vennar regulators and the Superintending Engineer's office at Trichinopoly.

As already mentioned, it is proposed by Government to transfer from the charge of the Roads and Buildings Branch of the Public Works Department to the Government of Bengal several of the Imperial roads and station buildings to the District Boards of Bengal, and with a view to effect larger savings, the Government has in contemplation to abolish from the commencement of the ensuing financial year (next April 1st) two or three executive divisions of the Bengal Roads and Building Works, and also to do away with one circle of Superintendency of the Public Works Department. One of these divisions will be the temporary Jessore Division, and the works of this division will be distributed to the Burdwan Division and Dacca Works. The Patna or Bhagalpore Division will, it is talked of, be also abolished. On the completion of these arrangements, Mr. T. Haines Wickes, C.E., Superintending Engineer, at present holding charge of the South Western Circle, will, in all probability, be transferred to his substantive appointment of the Western Circle Superintendency.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

"CHOICE AND CHANCE."

SIR,—May I trouble you or the readers of *INDIAN ENGINEERING* for a solution of the following problem :—

"A coin is tossed up 600 times daily for a period of 300 days. I wish to bet against the m^{th} toss of each day being a "head" for any five days in succession. What odds should I give to be neither a winner nor a loser at the end of 300 days ?

January 21, 1888.

KISMAT.

NATIVE ENGINEERS.

SIR,—I congratulate you on the success of your paper and the ability with which you are conducting it, while your fairness to all concerned, except perhaps native Engineers, is duly acknowledged.

There is no doubt you will be willing and ready to plead the cause of native Engineers also if their grievances are properly represented to you. We have many grievances, both as regards leave and furlough rules and slow promotions. We succeed very well when we have competent, just and sympathetic superior officers over us, and get our promotions all right. But when otherwise, the results are disastrous, and we are often many years behind the time. The truth is that Engineering is a practical science and opportunities and experience alone can bring about an approach to perfection, no matter whether the person practising the profession is an R. E. or a C. E. from Cooper's Hill College or other places in England, or is an alumni from the Indian colleges, without much influence or sympathy. The above considerations may, I hope, induce you to handle their case with fairness when an opportunity occurs. We are unwilling to enter into any discussion about our own case, lest the small sympathy now and then shewn to us may disappear, and the pinch upon us may be more severe.

L. C. E.

[While honestly thanking our correspondent for his kindly sentiments, and expressions of encouragement, we feel bound to protest against the charge of partiality so hastily preferred by him, as we have done on previous occasions. We have been thoroughly consistent in advocating the cause of the profession at large without evincing bias towards any particular section, as "L. C. E." will find if he takes the trouble to closely study our paper. Our motto is "A fair field and no favour," to which we have conformed to the best of our ability. Our columns are always open for the ventilation of just grievances whether they be of European or native Engineers. What we are desirous of instilling into the mind of the rising generation, irrespective of caste, creed or color is, that the cultivation of self-help ought to be the ground-work of all their present endeavors and future aspirations, and that total dependency on a *ma-bap* Government cannot be too strongly condemned.—ED., I. E.]

A GRIEVANCE AND ITS REMEDY.

SIR,—While article upon article is being written to ameliorate the condition of the superior officers of the P. W. D., is it not passing strange that nobody should consider it worth his while to say a few words on behalf of the much abused and down-trodden upper subordinates of the Department.

Since the last few years back, they appear to have become the disowned children of the parent Government, and their interest and welfare have not received the slightest sympathy either at the hands of their own departmental superiors, or the Government they serve under.

If the Executive Engineers treated their subordinates with the same familiarity and kindness that are shewn in other departments of Government service by higher grade officers to their immediate subordinates, then there would be no cause for the widespread grievance so frequently complained of, and which has naturally cast such a deep gloom over their minds. You have kindly said a few words in your issue of the 7th instant in their favor, and I think you can say more. The members of even the Lower Subordinate Establishment (the Sub-Overseers) of the P. W. D. were for a long time since its establishment treated as "Gazetted" officers, and now the same privilege is denied, most cruelly and unjustly, even to the Upper Subordinate grade men, members of which, as you justly say, are on the receipt of Rs. 500 to 600 a month. That men of the status and calibre of such men as the above should be denied a place in the *Gazette*, and the possession of a gun, without a pass, which, of all men, they require the most, is, to say the least, monstrous injustice, when people of very much inferior status enjoy both the above privileges.

It is hoped that our new Public Works Minister, Sir Charles Elliot, who has a reputation for vast ability and great impartiality, will kindly condescend to take up the case of the hitherto ill-treated and much abused upper subordinates, and with his reputed generosity remedy the evils they so loudly complain of; these are—

- No. 1. Their being restored to the status of "Gazetted" officers.
- No. 2. The promotion of higher grade and deserving Sub-Engineers to the Engineer grade, as they take it very hard, to be superseded by raw Cooper's Hill men and other outsiders, who are more interlopers.

FAIR-PLAY.

DEODAR VERSUS STEEL SLEEPERS.

SIR,—As my principal object in sending you the account of the Sukkur Bridge staging, which appeared in your issue of 5th November 1887, was to make known the superiority of pitch pine to deodar, I cannot allow the article by your respected correspondent, Rai Bahadur Kunhaya Lal, in your number of the 14th January, to pass without comment.

I will then repeat in greater detail, that the timber for the Sukkur Bridge staging was selected pitch pine in half and whole bulks of the required scantling, 40' long and over, sawn square, and perfectly straight in grain, and free from knots, and that it cost delivered at Sukkur Re. 1-9 per c. f.

The transverse strength of pitch pine is equal to teak, being to deodar as 9 to 7.

The pine in the staging has warped and twisted much less than the deodar, so that it is superior on this point also.

Now let anyone advertise for deodar up to this specification delivered anywhere on the Indus, and see how many tenders he will get. This is the practical view of the case.

Your correspondent is probably correct when he says in his second paragraph that deodar is the best Punjab timber, because there is simply no other, but the statement that it possesses strength and hardness is rather indefinite, since, as a matter of fact, the deodar of commerce is weaker, softer, and more knotty than any other building timber.

I should like to know where, and at what price, deodar can be got, as stated in the 9th paragraph, from 30' to 70' long and free from large knots, for it was the difficulty of obtaining even 30' timber of a reasonably good quality that induced me to try pitch pine. I once got a 60' log, but it was so knotty as to be useless. Even Memel seconds is a far superior timber to deodar.

But the point of the article is the use of deodar for sleepers. Here I think your correspondent is rather out of his depth, for he speaks of steel sleepers as *brittle* and *unfit* for railway purposes. And I think if he had to inspect for, say, 10,000 deodar sleepers, up to the quality he very properly insists upon as necessary, he would begin to doubt the ease with which such excellent timber could be procured. It will also be pleasing intelligence to the managers of railways, that such sleepers can be got from Re. 1-12.

One point must be remembered. It is the introduction of steel sleepers that has brought down the price of deodar, as every boy knows, who compares the rates for few a years back, and I hope that a knowledge of the price and quality of pitch pine will further break up the "timber ring" in the Punjab, which desirable effect has not been produced, for only during last year I could not buy deodar at Re. 1-8 from 26' to 30' long, without taking a lot of rubbish at the same rate. This timber, be it remembered, being in logs, on which the waste would have been 50 per cent., besides cost of sawing.

It is certainly desirable to develop the resources of the country, but enriching a few timber merchants is not exactly doing this.

The letter of "Blitz," in your issue of 10th December, is a more detailed attempt to prove the superiority of deodar sleepers, but is spoiled by the fact, that he takes an antiquated type of metal road, the pot sleeper, instead of the best now known, the stamped steel sleeper.

F. E. ROBERTSON,

SUKKUR; January 19, 1888.

Ex. Eng., Sukkur Bridge.

A SOFT IMPEACHMENT.

SIR,—Amongst the remarks contained in your last issue upon the subject of "A Polytechnic Institute for Bengal," I read the following :—"We are afraid that Mr. Spring's hopes stand but little chance of realization. The means likely to be adopted will be more general, more useful, and more practicable." I conclude that you refer to the expression of my views upon the subject of Technical Education which appeared in a pamphlet which I published about a year ago. From your remarks above referred to, and from my recollection of a former reference made by you to the same subject, I gather that you have not done me the honor of reading the pamphlet; should you now be at leisure to do so, you will find that so far from propounding, as you appear to imply that it does, a great scheme for the establishment in India of a system of Technical Education, such as would in your opinion be neither very useful nor very practicable, the pamphlet has done the very reverse.

The facts are these. In the early part of last year, there was a great craze on the subject, in connection with the Jubilee celebration, and with the idea of a Technical Institute in England. Much was spoken and more written upon a question which appeared to me to be but little understood, more especially as regards its application to Indian conditions. Funds were being subscribed, and speeches made all over the country, and there appeared to me to be every likelihood of Government and public bodies plunging hastily into action which they would probably afterwards regret.

The result of a long conversation on the whole subject with Mr. A. P. MacDonnell, Secretary to the Government of India in the Home Department, in which I expressed the above views, was that, at his request, I embodied my opinion in the shape of a note, which subsequently took the form of the pamphlet above referred to. I happened at the time to have by me a considerable mass of the literature of the subject, some of which was not ordinarily easy of access, and I hoped that by the publication of a

short *résumé* of some of this information, and by indicating what appeared to me to be the least unsafe lines of practical action, the risk of wasteful and unproductive expenditure might perhaps be lessened, and that by making it clear that there was more in the subject than appeared on the surface the wave of public opinion might usefully be stayed.

The pamphlet said in effect, "Don't spend money hastily: don't blindly imitate other countries: don't imagine that, except in very special localities, there is any need in India for technical schools, such as exist in considerable numbers elsewhere for the teaching of actual handicrafts: but if you will spend money, spend it cautiously and tentatively, in the way which I shall indicate, feeling your steps as you go: don't rush off and spend lakhs upon a great central institute, but endeavour to work slowly upwards from the humblest beginnings."

I have good reason for feeling satisfied that my advice has to a great extent been accepted; practical action has in some instances been taken as regards the encouragement of humbler schools, and, what is in my opinion of far greater importance, hasty action has been stayed. I have reason to hope that when the ideas of Government and of public bodies are sufficiently matured to permit of practical operation on a larger scale being safely begun, the cautious lines which have been indicated by me will to a great extent be adopted.

I may be permitted to quote the following remarks by the Director of Public Instruction, Bengal, relative to my views: "Mr. Spring told me that it was his intention to embody his views in a paper, and I readily consented to postpone taking any action in my department till he had completed it. The result is now seen in his essay on 'Technical Education for India,' and I have no hesitation in saying that it is by far the most useful and practical contribution to the subject that has yet appeared. It indicates with perfect clearness the possibilities and difficulties of the question, and shews in what various ways, and with what constant reference to different localities and industries, action must be taken if it is to be successful."

"In my opinion, Mr. Spring's paper furnishes for the first time a sound and permanent basis for practical action. The departments in India can now take up the question with the feeling of having ground under their feet."

I close this already too lengthy letter with the following remarks regarding Seebpore College. Your manner of referring to the Committee for the reorganization of the College, tends to give the impression that I am not a member of it. I may mention that, as a member of the Committee, since the commencement of its sittings, I have taken a leading part in its deliberations, and up to the present have had the gratification of seeing most of my suggestions concurred in by my fellow members. We are working in perfect harmony and accord, and our final recommendation to Government, will, I hope, result in the reorganization of the College upon the lines advocated by me since the commencement.

The tendency of such remarks on your part, as I have quoted at the commencement of this letter, is undoubtedly to disturb the unanimity and harmony with which, up to the present, the Committee have been working, and such being the case, it is, in my opinion, and I am sure in that of all who have the interests of the College at heart, much to be regretted that you should have seen fit to give expression to them.

FRANCIS J. E. SPRING.

[It seems to afford Mr. Spring great pleasure to hear his own voice, and to read his own effusions in type, or he would not have recklessly rushed into print. This Quixotic tilting at wind-mills evidently gives him pleasant occupation. It is purely a gratuitous assumption on his part to suppose the paragraph on the Polytechnic Institute for Bengal had particular reference to his pamphlet on Technical Education for India. His arguments are therefore irrelevant, unless he means to improve the occasion by earning a cheap advertisement for his publication by trumpeting forth his own praise. Mr. Spring had not the courtesy to send us a copy of his work, and we very foolishly went to the expense of procuring one, when we discovered our mistake. That we have not been singular in this view is amply borne out by the fact that many of our contemporaries—notably the *Civil and Military Gazette*—entertained the same opinion. The pamphlet was independently noticed by a contributor on page 306 of our issue of May 21, 1887, with a like result. The paragraph to which Mr. Spring takes exception nowhere even hinted that he was not a member of the Committee for the reorganization of the Seebpore Engineering College. On the contrary, we anticipated his obstructive temperament and his hostile attitude towards all genuine improvement. We are no believers in sudden conversion, but if the influence of Mr. Spring's colleagues has had any sobering effect on him, we are glad on his own account.—Ed., I. E.]

Literary Notices.

A MANUAL OF THE GEOLOGY OF INDIA. Part IV. Mineralogy. Calcutta. 1887.

THE book before us is, as its title declares, the 4th, and we presume the last part of "A Manual of the Geology of India" issued from the Office of the Geological Survey of India, a manual which may be regarded as a summary in a collated form of the work of the Survey down to the dates of the publication of its

several parts. The present volume is, from its subject-matter, necessarily the smallest of the four parts. It also labors under the disadvantages of being the least interesting, owing to its more purely scientific character, and at present the least practically useful as regards India, since, as its author points out, there is no demand in India for minerals as such, while not a single dealer in mineral specimens exists in the country; a fact which, in itself, sufficiently illustrates the lack of interest in the branch of natural science with which it deals.

Unfortunately few indeed of our Indian students exhibit any desire or habit for the prosecution of such natural studies. That this should be so after the many years' pursuit of the higher education that has been imported into this country must be laid to the door of the one-sided educational system in vogue, subordinating as it does all application and observation on the student's part to the mere grinding at text books, rather than to any inherent defects in the students themselves.

Those drawbacks to the usefulness of the work detract nothing, however, from the excellent way in which it has been dealt with, and its appearance will make a welcome addition to the libraries of all interested in mineralogical studies or research.

The work of the author having been largely that of compilation, criticism has very little to do. The book, however, abounds in records of his own labors as mineralogist to the department in the determination and examination of minerals found in India and forwarded to the museum for that and other purposes, and the analysis and descriptions of the various minerals scattered through its pages add very considerably to its value and usefulness; and this is still further enhanced by the many references—abundant indeed to satisfy the most captious of interested critics—to other authorities and sources of information on many of the specimens, from which more detailed information may be obtained.

Much labor has been spent upon the crystallographic branch of the subject, and though the number of crystal drawings are not many, considering the large number of minerals dealt with, yet they, together with the symbolic details of the faces, given in the text will convey a very good idea of the forms of the crystals to which only the symbols are attached. In this connection we may remark that we are glad to observe a marked uniformity in the methods adopted in crystal representations, a feature, from various causes, rarely met with in the works of our best mineralogists, and while adopting the classification of Dana, it is satisfactory to see that the notation initiated by that authority has not been followed in this case.

In the matter of chemical composition of minerals we would have preferred to have seen these given in pure and simple chemical notation, thus following the plan adopted in the most recent works on mineralogy. Our author has, however, preferred to retain a slight relic of the old mineralogical notation in the use of the "bar" in the sesquioxides, while in some cases, quotations from other authorities, an obsolete system of chemical notation has been given uncorrected. These, however, are small matters, though they may lead to confusion with our modern students.

Altogether we are glad to see the work, and in conjunction with Part III. of this manual, it will prove of scientific and practical value to all interested in the minerals and mineral resources of India, while to the few Indian students who devote themselves to this branch of natural science, it will prove invaluable as an extensively descriptive catalogue of the minerals exhibited in the Indian Museum, to which they must resort if they wish to acquire even an elementary sound knowledge of the subject.

THE TIMES OF INDIA CALENDAR AND DIRECTORY—1888. BOMBAY.

THIS is unquestionably the best got up DIRECTORY issued in India. It is of a convenient size, neatly printed, and well bound, while the contents form a repository of useful matter—both local and general. The five pages devoted to "Railways" afford particulars of general interest relative to all the non-Government lines not always obtainable in a collective form. The Bombay P. W. D. List is apparently the latest out. We observe that the appointment of "Joint Secretary" is omitted. Mr. Howard still acts as "Secretary to Government," holding the Temporary rank of Chief Engineer 1st Class; while Colonel Goodfellow is Chief Engineer for Irrigation with the Permanent rank of Chief Engineer 3rd Class. We cannot deal with a fraction of the information furnished by the Volume, and can only say that it is as varied as it is complete.

General Articles.

KARACHI HARBOUR WORKS.

MEMORANDUM OF WORKS IN PROGRESS OR PROPOSED AT
AN EARLY DATE FOR THE IMPROVEMENT OF THE
HARBOUR OF KARACHI.

Ship Wharfage.

(See accompanying Plan.)

AN iron screw-pile wharf 2,000 feet in length extending northward from a point 500 feet north of the shore abutment of the Merewether Pier, along the eastside of the "New Channel" leading to the Native Jetty.

The depth of water at low water springs for a width of 60 feet in front of the wharf is to be 26 feet, and thence to a distance of 500 feet the depth is to be 20 feet, so as to admit of swinging the vessels at or near high water.

This wharf is designed to accommodate five steamers of the largest class, and will be provided with twenty 35-cwt. hydraulic cranes and one 12-ton hydraulic crane, of which eight of the smaller cranes will be worked from the Merewether Pier engine, and the rest from a separate and more powerful engine to be placed about midway in the length of the wharf ground, and which will have a large margin of power for further extension of wharfage.

The wharf will abut on $19\frac{1}{2}$ acres of reclamation, on which will be five sheds, each 200 feet in length and 50 feet wide, all connected with the wharf and with the North-Western Railway, by a system of railway lines, from which the wharf can be worked either direct or with the intervention of the sheds, as traffic arrangements may require from time to time.

The number of sheds may probably hereafter be increased.

The amount of the estimate for the ship wharf including dredging and reclamation, &c., is Rs. 16,22,622, which is being provided by loan, a minor portion of which was raised in the public market, but the greater portion lent by the Government of India.

Judging from the results of the Merewether Pier, the extension of ship wharfage is likely to be highly profitable.

In connection with the wharf, the North-Western Railway officers are constructing a new line parallel with the Napier Mole, which will materially shorten the connection of Keamari with Karachi for commercial purposes, though the existing line along Keamari Island *via* the Chinna Creek embankment, to join the main line at the cantonment of Karachi, will still be retained, mainly for Trooping and Railway store purposes.

The ship wharfage and Railway lines, thus in progress, form an important beginning of the system of the Napier Mole wharfage, which has benefited by the strong support of the Honorable Sir Theodore Hope, late Public Works Member of the Government of India Council, who on two occasions, *i.e.*, in 1883 and 1885, visited Karachi in reference to the Harbour and Railway improvements.

The lately retired Commissioner in Sind, Mr. H. N. B. Erskine, C.S.I., took a warm interest in the wharfage and other projects of harbour improvement, and his name was in consequence given to the five ship wharf now in progress at a ceremony presided over by H. E. Lord Reay, Governor of Bombay, in January 1887.

The first portion of the wharf for two ships was brought into use on 18th August 1887, and the construction of the three ship portion is now being commenced with material procured through the India Office, as one of the conditions laid down by the Government of India in granting the further loan for the works.*

A beginning has also been made of the upper or north end of the "Napier Mole wharfage," in the shape of a boat wharf 680 feet in length, on iron (rail-built) piles, extending on a curve from the south end of the Napier Mole Bridge to the line of "New Channel," and including dredging of approach from the latter, and reclamation of 4 acres. This wharf can hereafter be converted into a ship wharf by an

additional row of piles in front, and the necessary further dredging.

The depth now available for boats is to be 12 feet at low water.

The estimate for this boat wharf is Rs. 2,21,164, which, as in the case of the ship wharf, is being provided for mainly by a loan from the Government of India.

Including the Merewether Pier, Karachi will therefore soon have wharf accommodation for six of the largest steamers, while there are great capabilities of extension on the same system, not only northward to the Napier Mole Bridge, but thence, by provision of a large swing bridge, to eastward of the Napier Mole, in progressive execution of the great tidal basin known as Sir Andrew Clarke's Scheme, but which, of course, must be only thought of now as in the distant future.

Dredging.

A large amount of dredging is also being carried on by means of four dredging vessels, not only in connection with the ship wharfage projects, but in improvement of the anchorage spaces of the lower harbour, especially in the east channel, and in maintenance of the entrance channel at its normal depth of 20 feet at low water.

For these various purposes an aggregate of 829,451 tons was dredged in the year 1886-87.

The maintenance dredging will, it is anticipated, be reduced hereafter by the works next mentioned.

Removal of Deep Water Point and Extension of the East Groyne.

The first-named work consists of the removal of a rocky projection $2\frac{1}{2}$ acres in extent, flanked by $12\frac{1}{2}$ acres of shingle mixed with sand, having a depth over it of from 2 to 11 feet at low water, extending nearly half way across the harbour on the west side near the root of Manora Point, and causing eddies which prevent safe anchorage at that part of the harbour, besides throttling the tidal flow and deflecting it from its proper course as regards the entrance channel and anchorage.

This work is estimated at $2\frac{1}{2}$ lakhs of rupees.

The curved extension of the east groyne, estimated at 1 lakh of rupees, is required to guide the flood tide, which circles round to the eastward before entering the harbour, and rushing abruptly across the end of the groyne, causes eddies and disturbance in the adjoining anchorage, and inner end of the entrance channel.

These two works, which several years ago were proposed and had since been frequently urged by the Port Engineer—Mr W. H. PRICE, M. I. C. E.—were sanctioned in 1886 by a grant from the Government of India.

Owing, however, to the necessity for procuring a large supply of steam drilling and lifting machinery from England, the greater part of which has now arrived, no large beginning has as yet been made at the removal of the Point, though the existing small party of native divers has been employed in cutting a drift preparatory to the larger operations.

These it is hoped to take in hand after all arrangements in the way of machinery, barges and explosives shall have been made, at the close of the present S.-W. monsoon, so as to complete the work within $2\frac{1}{2}$ years from that time.

The blasting and lifting work will be largely supplemented by dredging.

As regards the east groyne, 34,549 tons of rubble stone had been deposited up to the beginning of the present S.-W. monsoon, being about half the total quantity required, and making the bank to its full length on a narrow line and somewhat above its proposed height, *i.e.*, low water level.

The bank will probably have washed down considerably during the present S.-W. monsoon and can afterwards be raised and formed to its proper section with the help of some of the larger material from the Deep Water Point removal work.

Other Works.

The Government of India have further sanctioned a loan of 5 lakhs of rupees for deepening of the entrance

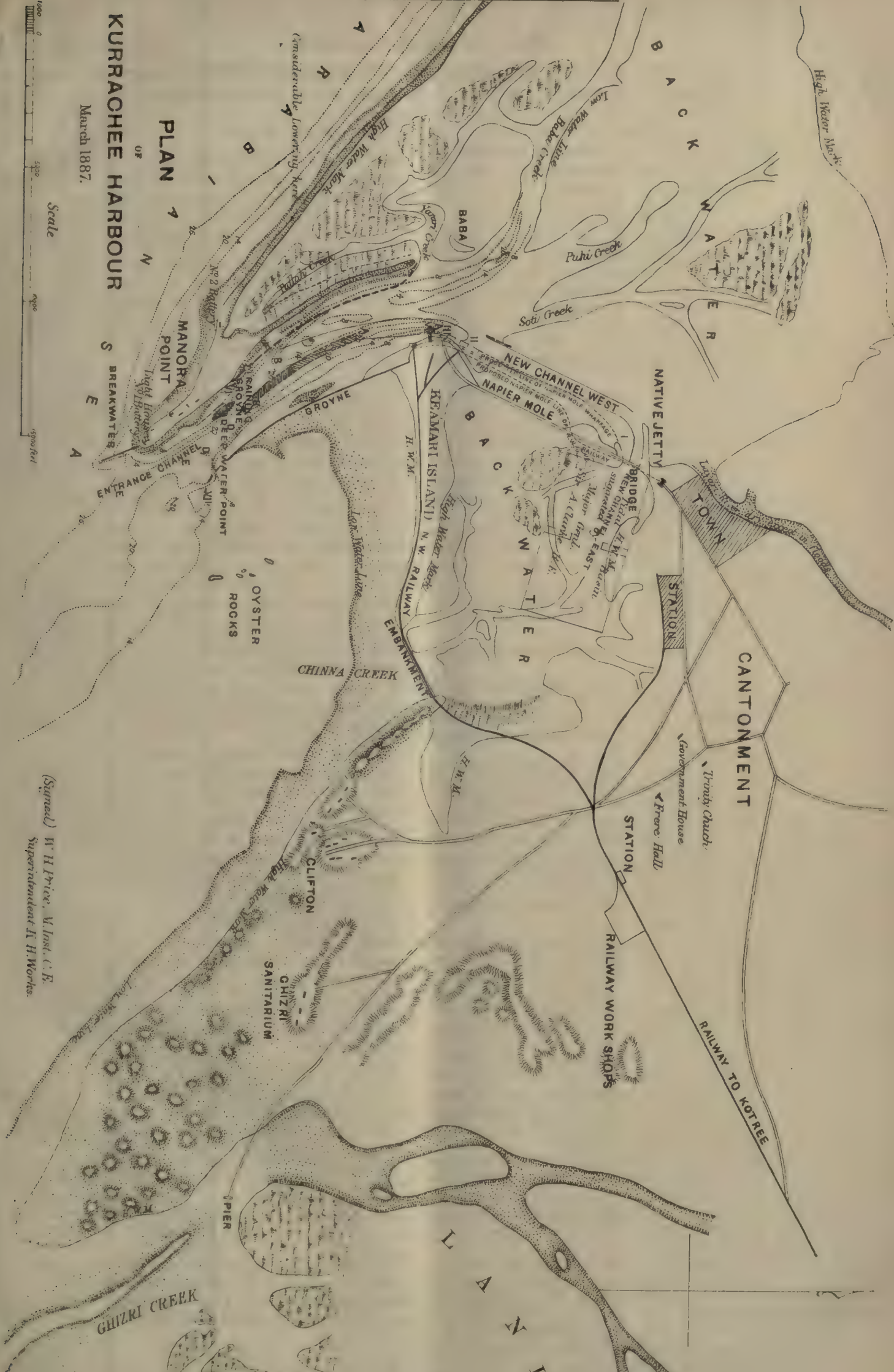
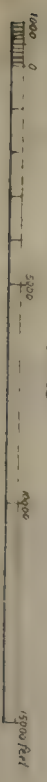
*Strange, but true!—Ed., J. E.

KURRACHEE HARBOUR

March 1887.

PLAN

Scale



(Signed) W. H. Irvine, M. Inst. C. E.
Superintendent H. H. Works.

by 2 feet, and additional dredging gear, moorings and main warehouses, the arrangements for utilization of which amount are under consideration.

The next work of importance calling for attention is the provision of a graving dock for the largest class of steamers, the accommodation of that kind being at present time limited to a small dock for the repairs of the vessels of the dredging fleet.

General.

The accompanying small plan of the harbour may help to illustrate the foregoing memorandum, by aid of the subjoined

REFERENCE.

- I Boat Wharf near South end of Napier Mole Bridge, nearly completed.
 - II Three Ship Wharf, iron work ordered & reclamation in progress.
 - III Two Do. in progress.
 - IV Boat Wharf at Keamari, nearly completed.
 - V East Channel, dredging in progress, and five moorings laid down.
 - VI Deep Water Point, removal sanctioned and plant in preparation.
 - VII East Pier (Groyne) Extension, in progress.
- * These form portions of the projected line of Napier Mole Wharfage. Boat Wharf opened for traffic, but some dredging & reclamation still remain to be done.

Napier Mole line N. W. Railway in progress, shown thus:—

A. A. Keamari	Anchorage.
B. B. Manora	Do.
C. C. West Channel	Do.
D. D. Deep Water	Do.
E. E. Entrance Channel.	

(To be continued.)

MAIL STEAMERS AND THEIR SPEEDS.

BY A. EWBANK.

V.

STEAM engines may be divided into various classes. The principle of the classification may possibly be the nature of the service rendered to labour. Or we might adopt another principle of classification and distinguish engines one from another by their internal arrangements.

As an example of the former kind of classification we may put a steam engine into one class if it draws a train, into another class if it pumps water out of a coal or a tin mine.

As an example of the latter mode of classification we may have one class composed of engines where the steam when it escapes is at a low pressure, while in another class the escaping steam is at a high pressure. By a high pressure we may mean anything decidedly greater than atmospheric pressure. By a low pressure we may mean anything decidedly less than atmospheric pressure.

In this discussion we will divide engines into stationary and locomotive. A locomotive engine runs away from its neighbourhood—it is constantly changing its surroundings. A stationary engine keeps its neighbourhood. By its neighbourhood we mean its material neighbourhood which is made up of buildings and natural scenery. For instance a stream of cold water may constantly flow near the engine and may have certain mechanical relations with the engine. This material neighbourhood being a part of the earth may indeed have a motion through space. But the engine, the buildings and the stream of water move always in company.

Now an engine employed to pump water out of a tin mine is certainly a stationary engine. A railway engine employed to draw trains is certainly a locomotive, i.e., a non-stationary machine. But how about the marine engine? Should we call it locomotive, or should we call it stationary. We prefer to class it with the stationary engines. For though it moves it carries its material neighbourhood with it. This material neighbourhood is the ship in which the engine is fixed. The ship may be in a river with a very rapid current. The ship may have her head pointed up stream. The engines may be working and the speed due to them may be exactly the same as that of the current. Shut off the steam and the ship drifts with the current at, say, six miles an hour. Put on steam and the ship—called a steamer—works her way through the current at the rate of six miles an hour. But a man on the bank watching the

steamer would say she was at rest. Whether the velocity due to the steam power exceeds, equals or falls short of the water-velocity due to currents is an accident, so to say. That is, the question does not affect the kind of steam engine or the nature of its action, though of course it does affect the intensity of the action.

Let us take an ordinary railway locomotive and let us suspend it above the ground in the manner already described. Round one of the driving wheels let us have an endless strap or band which also passes round a cylindrical body, which body we will not call a cylinder, but will call a drum, so as to distinguish it from the engine cylinder where the steam does its work. If steam is turned on, the driving wheel rotates. The endless band if sufficiently tight moves with the wheel and carries motion to the drum. This drum may then transmit power to some machinery. Here then we have transferred our locomotive into a stationary engine. This is always possible without any change in the mechanism.

Whether the locomotive makes a sufficiently economical stationary engine is another question. The locomotive was not primarily designed to be economical. It was primarily designed to make its wheels rotate fast when these wheels had a heavy drag upon them.

If when we suspend and fix the locomotive it has to put into rapid motion something comparable with the mass of a train, and if this mass in its rapid motion will encounter retarding frictions and other resistances comparable with those which a moving train experiences, then the locomotive is likely to do its new work well. Whether it could not by certain modifications or by certain additions do its new work just as well—but more cheaply as regards the coal it consumes—this is a separate question.

If the locomotive when suspended is intended to supply power to pump out water from a mine, then the new work is not comparable with the old work. One difference is that the pumping engine is not required to move fast. The piston of the pump is required to descend through the water with a certain measured and not rapid speed. As the piston descends a valve in it which opens upwards lets water pass above the piston. When the piston ascends its speed is still not to be great. The valve closes by the action of the water above it and a mass of water is lifted out of the mine. There is no use in lifting the water rapidly. When we make an excavation or sink a shaft, water frequently percolates in from the surrounding soil. The water generally enters at a certain measured pace, all we need do is to pump out water at a corresponding speed. If the engine moves more quickly the water is sooner removed, and then the pump piston moves up and down to no purpose, merely travelling each way through air. Also if we do attempt to make the piston move rapidly through water we immensely increase the labour. Here then is a case where the locomotive is not exactly the type of engine that we should build if we knew beforehand that the only work demanded from the engine would be to raise water from a mine.

All rapid motions are expensive as we might guess by our bodily faculties. Let us one day walk three miles at that rate which best suits our legs. Let us another day run a quarter of a mile at the fastest pace we can reach. Then let us compare the relative fatigues produced.

In the engine cylinder when the piston flies rapidly the steam does not expend so much of its power upon the piston as it would do if the piston moved slowly.

Imagine steam at a certain high pressure to be suddenly put into a space where it could expand without any counter-pressure. It will expand with great rapidity, but the rapidity will not be infinite. The particles of steam have some weight and they have to be put into motion by pressures behind them. These pressures may be great, but they are not infinite, therefore the steam particles move forwards at some non-infinite pace. Suppose in the engine cylinder

when fresh steam is admitted behind the piston, that the piston almost immediately flies forward at that same non-infinite pace. Then the steam will simply follow it. It will simply as it were keep up with it. It will not exert any pressure on the piston. At such a time the work got out of the steam's expansive power is *nil*. This, of course, is merely an extreme case. As another case let the piston move forward, but owing to great resistance let it move with extreme slowness. Here the steam pressure on the piston is nearly at its maximum, and accordingly much work is done. Between these widely different cases lie the ordinary cases that we have in engines. The faster the piston moves the less good we get out of the *next* supply of steam that comes to drive the piston. Generally therefore higher velocities mean smaller effects extracted from steam. In other words, for a *given* effect we need more steam, and therefore we consume more coal.

(To be continued.)

THE TANSÁ WORKS.

THE works of the Tansa Project for the additional water-supply of the City of Bombay are now in full progress. The lake of supply, situated about 60 miles from Bombay, is to be formed by the construction of a rubble masonry dam across the valley of the Tansa. The length of this dam is 9,000 feet and its greatest height, across the bed of the river, is 118 feet. This is the height to which it is to be built at present, but the section is so designed that it may hereafter, should additional storage be required, be raised to a height of 135 feet. The total estimated quantity of masonry in the dam, as at present being built, is 10,000,000 cube feet. The portion across the bed of the river, where the width of the base is 100 feet, has now (January 1888) been raised to a height of 41 feet. The masonry work is also in progress at different points on the north bank of the river where the height is comparatively small, being between 40 and 50 feet. The total quantity of masonry executed up to date is 1,300,000 cube feet. The average daily number of masons now employed is over 350. The supplying of material to this number of masons involves arrangements of considerable magnitude, and the total number of hands employed in connection with the dam works average about 4,000 daily. Numerous quarries have been opened in the neighbourhood of the dam and tramways have been laid from them to the site of the works. The lime used is obtained from kunker brought principally from the Nasik districts above the ghâts, a distance of some 40 miles from the works. The sand is obtained from the beds of rivers in the surrounding districts and it is now brought from an average distance of about 7 miles. As the work progresses this distance will increase, as the sand nearer to hand is used up. For the manufacture of the mortar 8 mortar pans driven by steam power are in use, besides several edge stone mills, or ghânis, which are used for portions of the work detached from the present principal centre of operations, namely, the portion of the dam across the bed of the river. The water required for the several operations connected with the work is supplied by two steam pumps (one on either bank of the river) from the lake formed by the water now impounded, and it is distributed all over the works by a system of pipes. The monthly outturn of masonry is now about 300,000 cube feet. The contractors for this work are Messrs. Glover & Co. The water is to be brought from Tansa to Ghât-kopar, a distance of 48 miles, by a duct consisting partly of tunnels through the hills, partly of a masonry conduit (cut and cover), and partly of 48" cast-iron pipes, or syphons, across the valleys. There are eight tunnels of various lengths aggregating 3 miles, the longest being 6,300 feet. The section of the tunnels is 9' x 6' and the gradient is 6 inches per mile. There are 26 miles of conduits, having a section 7 feet in width between the walls and 7 feet in height to the springing of the arch. The gradient

is 6 inches per mile. There are seven valleys crossed by 48" pipes giving an aggregate length of 19 miles. The hydraulic mean gradient of each line of pipes, or syphon, is 3.20 feet per mile. Work is in progress at several points along this length of 48 miles and a fair start has been made. Nearly all the tunnel faces have been opened. The shorter tunnels are being driven by hand labor and in the longer ones the drilling is done by compressed air machinery, the explosive used being dynamite. The excavations for the conduit are in progress and masonry has been commenced at several points. The earthwork of the syphon tracks on which the 48" pipes are to be laid is well advanced and the laying of the pipes of syphon No. 6, which is 11 miles long, has been commenced. This syphon crosses the Bassein creek, which separates the island of Salsette from the main land. The place selected for the crossing is at a point where the creek is divided into three channels by islands. The main channel is 1,500 feet wide and the two smaller channels each 400 feet wide. The 48" pipes are to be carried over these creeks on bridges of an uniform type.

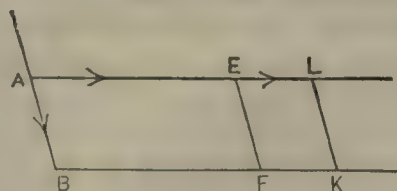
The superstructure consists of spans of 100 feet, centres, formed of a pair of lattice girders with cross girders on which the pipes are laid. The superstructure is supported on abutments and piers, each consisting of a pair of cast-iron cylinders 5 feet in diameter up to low water spring tide level, and above that level 4 feet in diameter. All the cylinders are carried down to rock and some of them have to be sunk to a depth of 60 feet under the bed of the creek. Each cylinder is to be filled with concrete and each pair of cylinders forming an abutment or a pier is to be braced together with heavy wrought-iron bracing. The work of sinking the cylinders is in progress and a considerable quantity of the material for the bridges is on the ground. The contractors for the whole of the duct works are Messrs. Walsh, Lovett, Mitchell and Co. The delivery of the 48" pipes for the syphons is in full progress and about 18,000 tons have been delivered. The total quantity of pipes required for the works is some 48,000 tons. The contractors for the pipes are Messrs. Macfarlane, Strang and Co of the Lochburn Iron Works, Glasgow. The water reaches Ghât-kopar at reduced level 306 on Town Hall datum or 226 feet above mean sea level. From this point into Bombay, a distance of about 12 miles, the water will be brought in pipes, consisting of a 48" main for the greater part of the way and afterwards branching into mains of smaller sizes. The line for this portion has not yet been finally located and the work has not been commenced. All the works have been designed by, and are being carried out under the direction of, Mr. W. Clerke, M. Inst. C.E.

PRINCIPLES OF MECHANICS.

By A. EWBANK.

IX.

Fig. 30.



WE have shewn that forces of $2P$ and P acting along AE , AB (fig. 30) have a resultant whose magnitude is undetermined, but which acts along the line AF . Here $AEFB$ is a parallelogram having $AE = 2AB$. Take $EL = AB$ and draw the parallelogram $ELKF$.

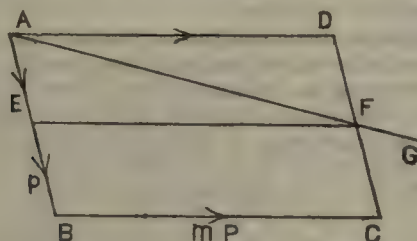
Then we will shew that forces at A of $3P$ along AL and P along AB have their resultant along AK . The proof is similar to the last case. We replace $3P$ at A by $2P$ at A and P at E .

Then by the last case we replace $2P$ at A acting along

AE and P along AB by a force y acting along AF. We then transfer y to the point F. There we replace y by a force of $2P$ along FK and P along EF produced. We transfer $2P$ to the point K and transfer the P force up to E. We now have $2P$ at K acting along FK produced, and two P forces at E. These two latter give a resultant along EK, because EK bisects the angle E. We transfer that resultant to K and there combine it with the force $2P$, which, we had already placed there.

Thus the resultant at A of $3P$ and P is equivalent to some force acting through K. Then, as before, we infer that the resultant of the forces at A must itself pass through K. Thus the theorem is proved for forces $3P$ and P. Similarly we may proceed and use this case to prove the theorem for forces $4P$ and P, and so on. Thus finally we have the theorem established as regards direction of resultant for two forces P and mP where m is any integer.

Fig. 31.



Next, in *fig. 31*, let ADCE and EFCB be equal parallelograms having $AD = mAE$.

Let us apply at A a force mP along AD and $2P$ along AB.

This system we change to the equivalent one of P at E along EB, P at A along AE and mP at A along AD. The two latter we now know to be replaceable by some force along AF. This force we take and we transfer it to F. At F we remove it and put in its stead a force of mP along EF produced and P along FC. The mP force we transfer to E and the P force we transfer to C. We now have P at C acting along FC produced and two forces at E. These two forces are mP along EF and P along EB. These we replace by some force along EC. This resultant force we transfer to C, and so all our force acts at C. But initially it all acted at A. Then, as before, we infer that mP and $2P$ at A give a resultant whose line of action is AC.

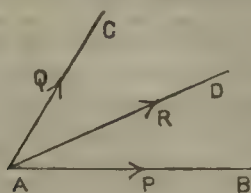
By adding as a third parallelogram we derive in a similar way the proof for mP and $3P$.

Thus ultimately we establish the theorem as regards the direction of the resultant for any forces mP , nP . As these numbers m , n , may be any whole numbers that we please, we consider the theorem to be always true.

The foregoing proof is found in many text books. It is merely expanded here to make each step easy to follow.

We have now to shew that the diagonal of a parallelogram represents also the magnitude of the resultant. Before giving the necessary proof some preliminary observations may be made.

Fig. 32.



If in *fig. 32* two forces P, Q are equivalent to some resultant R, then conversely a force R may be replaced by two other forces P and Q. To replace P and Q by R is called compounding P and Q. To replace R by P and Q is called resolving R.

If we resolve a force R along two chosen directions P

and Q, these directions must make such an angle ABC that R lies within that angle. For instance we could not resolve a horizontal force whose direction is north-east into two forces, one of which is due north and the other acts in a direction north-west. For the truth of this statement we appeal to the student's mechanical instinct or

Fig. 33.

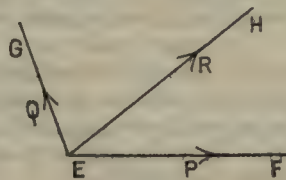
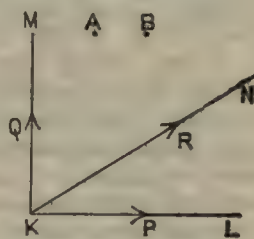


Fig. 34.



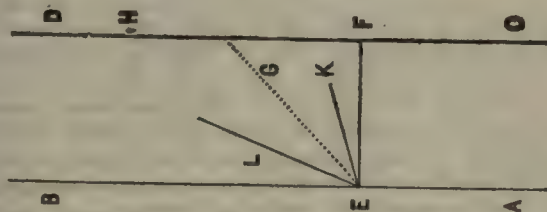
experience. In *fig. 33* we resolve R into two forces P, Q, which make an obtuse angle. In *fig. 34* we resolve R into two forces P, Q, which make a right angle. Now of these three ways—those illustrated by *figs. 32, 33, 34*, we consider that in the case represented by *fig. 34* the resolution of R is most completely effected.

The others are cases of, so to say, imperfect "resolution." For instance in *fig. 32* Q may itself be resolved into a certain force X acting along AB and a certain force Y acting perpendicular to AB. Then the ultimate—so to say—components are Y and $P+X$.

In *fig. 33* we may resolve Q into a certain force Y acting perpendicular to EF and a certain force X. This force X will not act along EF, but in the opposite direction. So here the ultimate components are Y and $P-X$. If X is greater than P the components in this last case are Y and $X-P$; and this latter force acts along FE produced.

But in *fig. 34* we cannot out of Q obtain any component to increase or diminish P. The components P, Q, are, so to say, quite independent of each other.

Fig. 35.



We may usefully illustrate this point by a case where motion actually takes place. Let *fig. 35* denote a river or canal of uniform width EF. Let a man start to swim, or to row in a boat, from the point E. Let the direction of his swimming or rowing be EG. Then the force of his rowing or swimming may be "resolved" into a certain force along, or parallel to, EF, and a certain force parallel to EB. Now it is on the first of these that his crossing the water depends. If the water has no current he will strike the opposite bank at a point on EG produced.

If it has a current, say towards B, he will not strike the bank on EG produced, but at some point H further down the stream. Nevertheless, current or no current, the time of his crossing the water will be the same, and this time depends only on that component of the rowing or swimming force which is along or parallel to EF.

We might indeed replace the force along EG by certain undetermined forces along EK and EL or along EF and EL. But such "resolutions" will give us no help to determining the time of crossing. If we resolve along EF and EL, the force along EL helps to effect the crossing, and this help must be taken into consideration.

If we resolve along EF and EB the force along EB does not help in the mere crossing, and therefore this component may be ignored if we are not asking *where* the man will reach the opposite bank, but only *when* he will reach it.

Thus returning to *fig. 34* we consider that R is here completely resolved into two forces P and Q. If we think of P without thinking of Q, we say that P is the "R force resolved along KL." If we think only of Q, we call it the R force resolved along KM.

If in *fig. 34* we had a number of forces R, S, T, &c., in the directions KN, KA, KB, &c., we could resolve each force along the two lines KL and KM. The components along KL we may call P, X, Y, &c. Those along KM we may call Q, U, V, &c. Then the system of forces along KN, KA, KB, &c., are equivalent to two forces. One of these is $P + X + Y$, &c. The other is $Q + U + V$, &c. Then, if necessary, we might recombine these two forces and so obtain the final resultant.

(To be continued.)

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

XXIII.

Lime pointing.

Items per 100 a. ft.	No. or quantity.	Rate.	Amount.	Total.
(1)	(2)	(3)	(4)	(5)
<i>Labor.</i> —				
Bricklayer No. ...	1	Variable.	Do.	Do.
Coolie " ...	$\frac{1}{2}$			
Do. " ...	2			
Bhistie " ...	$\frac{3}{4}$			
Grinding mortar, c. ft.	$1\frac{1}{4}$			
Sundries	.....		
<i>Materials.</i> —				
Slaked lime dry powder, c. ft. ...	6			
Sand ...	6			
Surkhi ...	6			
Sundries	.....		
Petty Establishment	.....		

NOTES FROM HOME.

(From our own Correspondent.)

A new automatic arrangement has recently been shewn on the Caledonian Railway for warning engine-drivers in the event of a signal being at "danger" when through fog or other causes the signal cannot be discerned. On the inside of the rail nearest the signal post, and just opposite to it, a plate is fixed having connection with the signal, while the engine has a system of levers arranged to come in contact with the plate or guide fixed to the rails. When the signal arm is placed at danger, the apparatus connected to the rail on which the engine and train are running is made to move upwards or sideways, so as to come in contact with a lever hanging in a vertical position, and connected with the apparatus actuating the brakes, bringing the train to a standstill automatically although full steam is applied to the engine. The experiments made both with passenger and goods trains are spoken of as a great success, and it is stated that the Caledonian Company intend to fix the apparatus to a number of important junctions and stations around Glasgow with a view of thoroughly testing this ingenious invention.

At a recent meeting of the Channel Tunnel Company Sir E. Watkin, the Chairman, considered that it was a hopeful sign in the prospects of the tunnel that Mr. Gladstone had publicly announced that he was in favor of the tunnel, that Mr. Bright was in favor of its construction, that the Marquis of Salisbury and Mr. W. H. Smith were in sympathy with those who were promoting it, and that Lord Randolph Churchill was a shareholder in the Company. Under these circumstances, Sir Edward thought when the Bill was brought forward in Parliament next session, it might

meet with a favorable reception, and so hopeful was he that he stated he was as sure the tunnel would be constructed as that he was standing there. The Board of Trade has, however, intimated to the promoters that if the Bill, which has recently been deposited by them, is persevered with, it will be the duty of the Government to oppose it in Parliament.

The London and North-Western Railway, in view of being probably the greatest sufferer by the construction of the Manchester Ship Canal, are contemplating a large expenditure upon Holyhead Harbor, and a considerable development of their already extensive accommodation there. It is stated that an American ship bringing cotton, cattle or merchandise for the London, Lancashire or Midland markets can unload and deliver it almost before a vessel can enter the Mersey, to say nothing of the 35-mile crawl along the canal to Manchester. It is said also that the Post Office authorities contemplate utilizing Holyhead for the perfecting of their mail system. There is no doubt that the development of Holyhead would mean the improvement of the trade of the whole of Wales, for Holyhead would play the part to North Wales that Cardiff does to South Wales.

The London, Chatham and Dover Railway having notified their desire to place larger and faster steamers than those at present performing the service between Dover and Calais, the Dover Harbor Board have entered upon an undertaking to widen the entrance to one of the principal docks where the Company's ships are now berthed. This is to entail a cost of £20,000. The two last additions to the Company's fleet, the *Empress* and the *Victoria*, have been constructed up to the last inch of beam which enables them to enter the docks. The Company intend, as soon as the projected works are completed, in order to insure greater steadiness and speed in all weather, to construct much larger vessels than the above, and these improvements will be again met by the Board who state their intention of then issuing fresh contracts for the further amelioration of the harbor.

Sir Juland Danvers, the Public Works Secretary to the Indian Government, in a paper read at the last meeting of the Statistical Society, pointed out that the solution of the problem of how a Railway can be most efficiently managed, and what is the proper basis for charges to the public, can only be ascertained by carefully recorded statistics, shewing not merely how many passengers are booked, and how many tons of goods are lifted, but the distances they are transported. In other words, we ought to have the total unit mileages under both coaching and merchandize—one passenger carried 1 mile being the passenger unit and 1 ton carried 1 mile being the unit of goods traffic. Sir Juland found by experience, in connection with the working of Indian Railways, that this information has served most useful economic and administrative purposes, and that it furnishes the only sound basis on which economical management can be tested. It is curious to note that this information is included in colonial and continental railway returns, but is studiously excluded from the accounts of English Railways, and the attempt to draw comparisons between the workings of English and other lines is thus baffled. From tables shewing the working of Indian Railways it was shewn that on the East Indian each passenger was conveyed at a cost of little more than 3 tenths of a farthing per mile at a profit of about 7 tenths of a farthing, being 230 per cent. of the cost, and each ton was carried at the cost of about 4 fifths of a farthing at a profit of 1 and 2 fifths of a farthing, being 175 per cent. on the cost.

Sir Robert Rawlinson C.B., Chief Engineering Inspector of the Local Government Board, is about to retire. He has held the appointment ever since the Board was formed, and his name is synonymous with the progress of Sanitary Engineering, of which he may be said to be the father. Sir Robert is the author of numerous scientific reports and papers and his suggestions for the use of local Surveyors and Sanitary Engineers has been accepted as authoritative both in England and abroad. His professional career has been a long and useful one, and now at the ripe age of seventy-six thinks it is time to rest from the toils of office. He is made a K.O.B. on his retirement.

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

THE New York District Railway Company, a corporate body, having for its object the construction of an underground railroad in New York for rapid transit purposes, will build two separate branches spanning the city from river to river.

The main line will start from the lower end of the city, and run straight up to Central Park. At or near Madison Square another branch will be built, and run clear through to the Harlem River. A four-track road will be constructed along the entire line, so as to admit of both accommodation and express trains. These tracks will occupy a width of only 35 feet in the middle of the street, thus leaving a space of 24½ feet from the nearest house line on both sides. No vaults or areas will thus be disturbed, and the Company will provide suitable and accessible galleries for the protection of all pipes and wires at every house front on the line.

According to the designs, each train will consist of 10 cars with a combined seating capacity of 500. Electric locomotives of 300 horse-power will be used, one at each end of the train. The cars will be so constructed as to seem to be on a level with the road bed, the object being to make the attraction of gravity so small that it will be impossible for them to upset. No wood or glass will be used in the construction of the cars. The whole frame work will be formed of steel, and where wood is generally employed a net-work of steel covered with a specially prepared flax will be used. The electric motors, besides driving the trains, are supplied with automatic appliances for lighting cars, supplying fresh currents of air every eight minutes, opening and shutting the gates, and signalling the stations. At intervals of about every seven blocks, corner houses will be bought and turned into stations. As soon as the consent of the owners of one-half the value of the property on the proposed line is obtained, the Company will begin operations. The time required for the construction of the road is estimated at four months, and work will be commenced early this winter.

Referring to the Panama Canal, *The New York Times*, says:—"The unfortunate holders of Panama Canal shares and bonds must be in a puzzled frame of mind. A few days ago, M. Victor de Lesseps proclaimed that no further loan would be needed for the company. Now M. Ferdinand de Lesseps appeals to Premier Rouvier for authority to raise a new loan by means of an issue of lottery bonds. The loan of last August was procured by inducements closely resembling those of a lottery scheme, but the plan then used was not the one which can be used only with the Government's sanction and implied support, and which is more enticing to the ignorant. At the same time, M. de Lesseps announces that he is negotiating with a noted Engineer for the purpose of insuring the digging of a passage sufficient for a traffic of 7,500,000 tons, reserving the completion of the work for the future. What a pitiable spectacle this is of an old man near his grave trying to draw more money from the pockets of his dupes in the rural districts and villages of France, whose hard earned savings must be soon swept away!

Arrangements have been made to send out eight Engineering parties in the latter part of November to locate the route of the Nicaragua Canal. The preliminary surveys are completed, and besides the route their work will be to locate the dams, sites, locks, etc. They will be equipped with boring machines, and will ascertain the various strata to be excavated. It is said their work will be completed in eight months, and that by 1st July 1888 the work of excavation will begin. The whole work to be complete and in active operation inside of six years. A syndicate of New York, Baltimore and Richmond gentlemen constitute the private corporation which has the matter in charge. The total cost will be about \$65,000,000. It will not be all outlay, as revenue will accrue from the sale of the lands granted by the Government, and from the railway and telegraph lines to be built along the line to aid in its construction. After the canal is completed, it is calculated that one-half of the revenue will come from California, Oregon and British Columbia products.

The Pennsylvania Railroad will, about 1st November, make an advance in the freight rate on iron and steel products for shipment westward, which will amount to an increase of eight per cent,

This road has been experimenting for some time with an automatic whistle, the object of which is to give the signal at grade crossings whether the Engineer is awake or asleep. The device is a very simple one, consisting simply of a bar or lever connecting with the whistle, and extending down to within an inch of the track. At a point 600 yards from the crossing a projection is placed, which, striking against the lever, starts the whistle. Should the engineer be asleep, the shrill note of the whistle directly over his head would

undoubtedly awaken him. The fourth track on the New York division of this road is being rapidly pushed, and it will be completed about the first of the coming year.

The Annual Report of the General Superintendent of the United States Railway Mail Service shews that at the close of the last fiscal year (30th June 1887) Mail Service had been authorized upon 130,959 miles of railroad, postal clerks being employed distributing the mail on 116,609, service on the remaining 14,350 miles being performed by closed pouches. At this date there were in operation 41 inland steamboat routes, aggregating 5,864 miles on which postal clerks were employed. To handle the mails while in transit there were employed on railroad routes 4,403, and on steamboat routes, 57 railway postal clerks, being a total of 4,460 men. While in the performance of their duties, the postal clerks on railroads travelled in crews 107,067,643 miles, and those employed on steamboat 1,868,747 miles.

During the year there were 244 derailments or wrecks of trains on which postal clerks were employed. In these wrecks three clerks were killed, 45 seriously and 72 slightly injured.

The Union Canal, which was the first canal projected on the American Continent, is offered for sale. This canal was suggested by William Penn in 1690, and its route was surveyed 70 years later, before there was a canal in operation in England. The route of this canal was surveyed in 1762. It extended from the Schuylkill River near Reading in Pennsylvania, to the Susquehanna, at the present site of Middletown. It was the first link in a proposed chain of water communication between the Delaware River and Lake Erie, a project so gigantic for that early day, when canals and even turnpikes were unknown, that the projectors were believed to be crazy. This route was surveyed by David Rittenhouse, an astronomer, and Dr. William Smith of the University of Pennsylvania. Mr. Rittenhouse planned a system of inclined planes to overcome the Alleghany Mountains, a plan which was adopted nearly 75 years after, by the State in its old Postage Railroad.

The Revolutionary War interrupted work on the Pioneer Canal, and in 1791 Robert Morris and Robert Fulton became interested in it, but the work was too far in advance of the times, and it was not completed until 1827. The canal is 89 miles in length, and some of the greatest Engineering work of that day was necessary in its construction. The first tunnel in the United States was bored for this canal through 800 feet of solid rock, and the summit of the canal being higher than its terminal feeder, a pumping apparatus had to be constructed to raise the water to the proper height. The canal cost £5,000,000.

MATHESON & GRANT'S HALF-YEARLY ENGINEERING TRADES' REPORT.

TRADE has continued to improve during the last three months; there has been a marked increase in the value of exports, and in most branches of Engineering the prospects for the opening year are favorable. The introduction of late years of automatic and labor-saving machinery has much to do with the low prices that prevail, for while the volume of trade has increased, the producing power of the country has grown still more rapidly. The revival must to some extent be associated with that in the United States which preceded it, and this great activity in America where, during the past year, more than 10,000 miles of new Railway have been constructed, seems likely to continue. There is no immediate prospect of any reduction in the tariff as seemed foreshadowed by the President's message to Congress, and this postpones a serious and possibly overpowering competition with Great Britain which will arise directly the removal of protective duties in the United States brings the cost of living, and therefore that of production to a normal level and allows full development of the enormous natural resources of the country.

COAL.—Prices in South Wales fell from 3d. to 6d. since the advance in July, owing in some cases to a readjustment of royalties involving an increased output. In the North of England prices are steady, and the revival in the steel and other trades is tending to maintain and enhance the prices of coal and coke for all metallurgical purposes.

IRON.—The sudden and great rise during the last three months in the prices of copper, tin and other metals gave the stimulus which alone was wanting to an advance in the values of iron and steel, which had continued to fall after the issue of our July Report. This advance has been supported by a genuine growing demand, as well as by the speculative dealings of those anticipating a further rise, but the large stocks of pig iron, and the producing capacity available render any but a slow movement unjustifiable. The quantity of pig iron manufactured at Cleveland in 1887 was less than in 1886, but the difference was more than made up by the increase in the quantity of basic pig or steel, made in the same locality. Rolled iron has for a considerable time been selling at prices hardly repaying the deterioration of the plant producing it, and the slight improvement in price is rather a reflection of that in steel, than due as yet to any increased demand. If however the consumption does grow, the reduction of late years in the number

of puddling furnaces would now assist in an improvement of prices. High-class Yorkshire iron of the Farnley or Lowmoor type suffers most from the rivalry of steel, and it is likely that the future of such iron will lie rather in the direction of bars for various smithing purposes than as heretofore of plates for flanging and other severe treatment.

STEEL has risen in price, this being partly due to the advance in Cumberland and Spanish hematite ore (the latter because of higher freights from Bilbao), but in the case of plates and other structural material to the greater demand. The revival of the ship building industry has had a direct and immediate effect, but it is yet to be seen how far the enormous productive power, now equal for plates alone to about 10,000 tons per week, will keep prices from advancing further. The rail trade has been only moderately active during the last six months; some large colonial and other orders have just been placed, but at present the prospects for the new year are not well assured. The hoped for demand from the United States has been checked by the fall in prices there, where there is a combined action among rail makers to meet European competition, notwithstanding the rise in prices in that country of all other Engineering material. Nearly two millions of tons of steel rails have been made in America during the past year. An increase of exports seems likely from Great Britain to the Southern States and to the Pacific coast, where cheap ocean freights allow sea-borne rails to compete with American products. In Sheffield the prices of tires, springs and other more expensive forms of steel are also rising in sympathy with the general advance.

The following list shows the fluctuations in values during the last five years :—

	PER TON.											
	January 1883.	January 1884.	January 1885.	January 1886.	January 1887.	July 1887.	January 1888					
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.					
Steam Coal, f.o.b. at Carliff	0 11 00	12 00 00	10 90 90	9 60 80	9 30 90	9 30 90	9 30 90					
West Hartley Coal, f.o.b. at Newcastle	0 9 00	9 60 90	8 60 80	8 60 80	8 60 80	8 60 80	8 60 80					
Pig Iron at Glasgow, No. 3	2 9 02	3 62 26	2 62 10	4 62 26	2 62 30	2 62 30	2 62 30					
Pig Iron at Middlesborough, No. 3	2 2 61	16 61 15	61 11 61	14 01 14	61 13 61	61 13 61	61 13 61					
Iron Ship Plates at Middlesborough	6 10 05	12 64 17	64 12 64	12 64 12	64 12 64	15 0 15	0 15 00					
Iron Bridge Plates in South Yorkshire	8 0 07	5 06 10	05 17 65	7 65 7 65	7 66 00	7 66 00	7 66 00					
Steel Ship and Bridge Plates	10 0 08	10 07 00	06 17 66	5 06 5 07	00 00 00	00 00 00	00 00 00					
Iron Rails, f.o.b.	5 0 05	00 00 00	00 00 00	00 00 00	00 00 00	00 00 00	00 00 00					
Steel Rails, f.o.b.	5 5 04	10 05 00	05 00 04	5 04 3 04	3 04 3 04	3 04 3 04	3 04 3 04					

(To be continued.)

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, January 21, 1888.

Upper Burma.

With reference to *Gazette of India* Notification, dated the 17th November 1887, Mr. H. Groves, Executive Engineer, 2nd grade, on transfer from India, is posted to the Chindwin Division, of which he assumed charge on the afternoon of the 22nd December 1887.

With reference to *Gazette of India* Notification, dated the 14th December 1887, Mr. P. W. Gilliland, Assistant Engineer, 2nd grade, reported his arrival at Mandalay on the forenoon of the 9th instant and is posted to the Mandalay Division.

Burma State Railway.

Mr. G. Deuchars, Executive Engineer, 4th grade, temporary rank, Toungoo-Mandalay Extension, reported his return from three months' privilege leave granted to him in this office Notification, dated the 30th September 1887, on the forenoon of the 9th January 1888.

Madras, January 24, 1888.

The following promotion is made :—

Mr. C. W. Wood, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, permanent, with effect from 5th January 1888.

Bombay, January 26, 1888.

His Excellency the Governor in Council is pleased to appoint Mr. D. George, Assoc. M. Inst. C.E., Assistant Engineer, 1st grade, on return from furlough, to act as Executive Engineer, Ghar Canals.

Railway.

With reference to Government of India, Public Works Department, Notification of the 14th January 1888, Mr. A. S. Gerrard, Executive Engineer, 2nd grade, is appointed to the charge of the Kanara Forest Railway Survey.

Punjab, January 26, 1888.

His Honor the Lieutenant-Governor is pleased to sanction the following temporary promotions and reversions in the Amalgamated Engineer Establishment of the General and Irrigation Branches of the Public Works Department, Punjab, with effect from the dates specified against each :—

Rai Kanhaya Lal, Sahib, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 29th September 1887, vice Mr. Ivens proceeded on furlough.

Rai Kanhaya Lal, Sahib, Executive Engineer, 4th grade, temporary rank, to revert to Assistant Engineer, 1st grade, with effect from 28th October 1887, on Mr. Pargiter's return from furlough.

Rai Kanhaya Lal, Sahib, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 29th October 1887, vice Mr. Tufnell proceeded on furlough.

N.-W. P. and Oudh, January 28, 1888.

Irrigation Branch.

With reference to Notification, dated 5th January 1888, posting him to the 2nd Circle, Irrigation Works, Mr. C. T. Evans, Executive Engineer, 2nd grade, is posted to the Cawnpore Division, Lower Ganges Canal.

Mr. J. R. C. Nicolls, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India seven months' furlough, in extension of that granted him in Notification dated the 1st March 1887.

India, January 28, 1888.

Mr. A. Sprenger, Executive Engineer, 1st grade, Assam (on furlough), is granted special leave for two years, under the terms of Public Works Department Notifications of 3rd October 1887.

The following transfers are ordered :—

Rai Sahib Kali Podo Sen, Executive Engineer, 4th grade, sub. *pro tem.*, State Railways, to Bengal.

Rai Sahib Kali Sunkur Chatterjee, Executive Engineer, 4th grade, temporary rank, Bengal, to the Establishment under the Director-General of Railways.

In continuation of Notification, dated 20th January 1888, the Governor-General in Council is pleased to order the following promotion in the class of Superintending Engineers, with effect from the 9th November 1887 :—

Lieutenant-Colonel G. T. Skipwith, R.E., Executive Engineer, 1st grade, and Superintending Engineer, 2nd class, temporary rank, to be Superintending Engineer, 3rd class, permanent, and Superintending Engineer, 2nd class, sub. *pro tem.*

The services of Mr. F. Wolley-Dod, Executive Engineer, 4th grade, sub. *pro tem.*, State Railways, are placed at the disposal of the Foreign Department for employment in the Kashmir State.

Military Works Department.

The services of Lieutenant M. Nathan, R.E., are placed temporarily at the disposal of the Inspector-General of Military Works for employment on defences. He will, while so employed, hold the rank of Executive Engineer, 4th grade, from the 14th October 1887.

The following promotions and reversions in the Engineer Establishment of the Military Works Department are sanctioned, with effect from the dates specified :—

Lieutenant G. Williams, R.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 2nd October 1887.

Lieutenant G. Williams, R.E., Executive Engineer, 4th grade, temporary rank, to revert to Assistant Engineer, 1st grade, with effect from 4th October 1887.

Lieutenant G. Williams, R.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 15th October 1887.

Lieutenant W. Huskisson, R.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 16th October 1887.

Lieutenant W. Huskisson, R.E., Executive Engineer, 4th grade, temporary rank, to revert to Assistant Engineer, 1st grade, with effect from 31st October 1887.

Captain R. V. Phillpotts, R.E., Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, permanent, with effect from 1st November 1887.

Captain G. M. Porter, R.E., Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, permanent, with effect from 1st November 1887.

Lieutenant W. Huskisson, R.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 1st November 1887.

Lieutenant T. F. B. Renny-Tailyour, R.E., Assistant Engineer, 1st grade, sub. *pro tem.*, to be Assistant Engineer, 1st grade, permanent, with effect from 1st November 1887.

Lieutenant M. S. Tukey, R.E., Assistant Engineer, 2nd grade, sub. *pro tem.*, to be Assistant Engineer, 2nd grade, permanent, with effect from 1st November 1887.

Lieutenant R. J. H. L. Mackenzie, R.E., Assistant Engineer, 2nd grade, temporary rank, to be Assistant Engineer, 2nd grade, permanent, with effect from 1st November 1887.

Bengal, February 1, 1888.

Establishment—General.

The Lieutenant-Governor is pleased to make the following promotions in the Engineer Establishment, with effect from the 28th December 1887 :—

Mr. C. J. K. Watson, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent.

Mr. W. Milne, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, permanent.

Mr. J. S. L. Long, Assistant Engineer, 1st grade, sub. *pro tem.*, to be Assistant Engineer, 1st grade, permanent.

Irrigation.

Rai Krith Chunder Chowdry, Sahib, Assistant Engineer, is transferred from the Office of the Superintending Engineer, South-Western Circle, to the Balasore Division.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 26th January 1888.

- 142 of '87.—The Newell Universal Mill Company (Incorporated) of the City and State of New York, United States of America.—For improvements in Sugarcane shredders.
- 228 of '87.—James Fox Mellor and Benjamin Fox Mellor, both of Adelaide, in the Province of South Australia, Agricultural Implement Makers.—For improvements in and connected with belts or straps for transmitting motion.
- 241 of '87.—Desmond Gerald FitzGerald, of 6, Akerman Road, Brixton, in the County of Surrey, England, Electrician.—For improvements in the production of coherent masses of peroxide of lead for use as voltaic battery elements, and for use in electrolytical and metallurgical operations.

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Tenders will be received at the office of the Controller of Stores, East Indian Railway Company, Fairlie Place, Calcutta, up to noon of Wednesday, the 29th February, 1888, for the purchase of surplus and condemned stores as above, at Howrah, Giridih, Asansol, Jamalpur, Dinapore, Allahabad, Cawnpore, Ferozabad, Tundla, Agra Junction, Bhandai, and Ghaziabad.

Tenders must be submitted in the form to be obtained at the office of the Controller of Stores, where printed lists of the stores can also be had, and tenders submitted in any other way will not be considered.

The various lots are open to inspection by intending purchasers on application to the Storekeepers in charge of the depôts where the stores are respectively located.

D. W. CAMPBELL,
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Calcutta, January 27, 1888.

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Candidates must apply stating age on or before the 27th February 1888.

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DINAGPORE DISTRICT BOARD'S OFFICE,
The 14th January 1888.

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EDITORIAL ANNOUNCEMENTS.

AN Index of the contents of Volume II. with a title page will be issued with our next number.

Contributors would doubly favor us by having any drawings or sketches that may accompany their articles prepared of a size to suit the pages or columns of the Journal.

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INDIAN ENGINEERING.

SATURDAY, FEBRUARY 11, 1888.

THE BOMBAY P. W. D.

THE latest Classified List of the Bombay P. W. D. shows the *status quo* of mystery and uncertainty unaltered. We find the "General Buildings and Roads, and Irrigation Branches" administered by one Secretary, and the appointment of "Joint Secretary" is non-existent.

The re-organization scheme for the Department being still under discussion, the temporary promotions in lieu of officers who went home in April last are still withheld to the great loss and discontent of those concerned.

One of the alterations which it is surmised that the Governor of Bombay is desirous of instituting is to subdivide the dual appointment of Chief Engineer and Secretary to Government. This plan was tried before in 1861, and was found not to answer; hence the rule in the P. W. Code that the senior Chief Engineer shall be the Secretary to Government.

This is evidently right, for unless the senior or the most capable Engineer is associated with, and possesses the confidence of, Government, there will be no unity nor firmness in the administration.

The Department should have a single head to select men for the different posts, to decide appeals made from the decisions of the Superintending Engineers, and to settle the hundred-and-one questions that crop up affecting the Department as a whole. If there is also a Secretary junior to the Chief Engineer, and yet not directly under his orders, there will practically be two heads of the Department, the Government acting through its Secretary and the Chief Engineer. This is bound to cause friction, unless the latter is weak enough to consent to self-effacement. It is hoped, however, that no alteration will be allowed in the Code rules in this direction.

THE INDIAN TELEGRAPH DEPARTMENT'S WORK.

THE Indian Telegraph Department did good work during the official year 1886-87, especially in Upper Burma, in connection with the war. The value of the aid rendered there to military operations has been acknowledged alike by the Commander-in-Chief and the Government of India. Of the 2524 miles of new line, and the 5410 miles of wires, with incidental construction works, many were carried out with infinite pains, and under many disadvantages, in England's new Eastern dominion. They involved hard work and hardship, not only on all employed there, high and low, but on many departmental officials at many Indian stations.

Excluding Burma and its anarchies from the calculation, the Director General of Telegraphs claims a marked reduction in interruptions to the working of his lines last year, as compared with previous years, and modestly exults in the fact that for efficiency of its line maintenance, the Indian Department "continues to take precedence of all other telegraphic administrations." Nor is it less successful financially. In the Government Resolution

on its last year's working we find it written: A general review of the financial results of the year, then, as compared with those immediately preceding it, shews a decreasing expenditure on capital, a very marked increase in gross revenue, a moderate increase in working expenses, and a large rise in net revenue. These results, regarded from the point of view of telegraphic administration, are sound and satisfactory, as indicating the well-organised power which lies in the Telegraph Department to cope with the increase in work which is represented by the large increase in the gross receipts.

Having thus liberally bepraised the Department, Colonel Pemberton goes on to suggest with bad grace that 9 lakhs of the increase claimed for successful financial working is "spurious" since it must be set down to State telegrams, and suggests that they are dummies, and ought not to count. Nevertheless the Department *earns* the increase. But for it Government would have to pay for what Colonel Pemberton is pleased to call dummies. And having to pay we doubt whether half the number of State messages now passing over Indian lines would not be found messages of supererogation instead of "spurious" messages. But that is by the way.

With regard to the system of quadruplex working between Madras and Bombay, introduced a couple of years ago, we are told that it has worked with a fair amount of success; but that owing to the length of the circuit, and climatic and other causes, its stability has not yet proved quite equal to that obtained in other countries, with generally much shorter distances, and more favourable physical conditions. That matter of the long distances over which electricity has to be transmitted along many of the lines under the control of the Indian Telegraph Department is one very often lost sight of. It is between the great trading centres lying many hundreds of miles away from one another between which the bulk of the work has to be carried on, and not between towns that are more or less close together, as they are in England and on the Continent. In order to deal with Indian long distances, the conductivity of the wires and the sensitiveness of the instruments used by the Indian Department are fixed at a much higher standard than is usual in other countries. It appears that in spite of these precautions, and the advantage taken of automatic retransmission, a good deal of repetition of messages is found necessary. Besides the introduction of quadruplex working referred to above, duplex working has been considerably extended and in some important details improved. The use of hard drawn copper wire in place of iron wire is departmentally approved of, and is to be extended.

Its disadvantages are the need of very careful handling in its erection, and its high rate of expansion and contraction under changes of temperature, but the former can be overcome by the employment of properly trained workmen, and the latter may almost be disregarded in consideration of its immense electrical superiority. The high conductivity of copper as compared with iron is well known, but when hard drawn and pure it is found to possess great mechanical strength, and is practically free from the electro-magnetic inertia which in iron wires so seriously retards the

transmission of electricity. In India, where the distances are so enormous compared with those of most other countries, this quality will prove of the greatest value, and marked improvement is confidently expected from its use on some of the long circuits.

We are glad to hear that in the Departmental workshops many things were manufactured last year, which formerly had to be imported from England. The workshops also repaired a lot of instruments, turned out large quantities of line stores, and issued several thousand items of electrical apparatus. Their outturn is valued at Rs. 5,23,435.

There were 326 combined post and telegraph offices open at the end of the year, connected with trunk lines by 4,285 miles of wire; and messages aggregating more than 5½ lakhs of rupees in value were despatched from them, a large proportion by the native community. This is a sign of the times, and an encouraging one. *Apropos*, we find the Director-General of telegraphs writing:

2,516,826 paid telegrams were despatched, against 2,289,938 in 1885-86, an increase of 226,888, of which 155,768, or nearly 70 per cent., were Inland Private Telegrams. Although satisfactory as an indication of the growing appreciation by the public of the enlarged facilities afforded in recent years, this increase can hardly yet be regarded as an adequate response to the extent of those facilities. It is, however, not unreasonable to expect that the native public will in time appreciate, at its full value, the means of rapid communication which have been so widely extended in their interests, and that this class of traffic will assume far larger proportions: it has already increased 42 per cent. under the stimulus of the extensions effected during the last four years.

SIR ALFRED LYALL AND HIS SATRAPY.

II.

WE continue our commentary on Sir Alfred Lyall's account of his stewardship as Lieutenant-Governor of the North-West Provinces and Chief Commissioner of Oudh. Chapter VI. of his apologia is labelled "Land Revenue," and deals with a good many miscellaneous subjects over and above rent assessments and realizations, supervising Kanungos, and the education of Patwaris—"and their heirs"—in survey work and mensuration, the use of the plane table, and arithmetic. A Revenue Board move in a decidedly right direction is the pargana book which has to be kept at every tahsil with the object of collecting and tabulating statistics and information as to the circumstances and conditions of every estate lying within its boundaries. Officers of Government are required when on tour to inspect this record; to scrutinize carefully all entries made in it; to make notes in it of any facts materially affecting the economic condition of the people which may have come under their own notice. It is obvious that a latter day Domesday book of this description may become a very valuable economic register, and work of reference, as well as an authoritative record of rights in property.

At the commencement of Sir Alfred Lyall's reign the services of an additional Engineer were placed at the disposal of the Agricultural Department, to investigate subterranean water-supplies, the modes of construction, and

cost of the different kinds of wells used in different parts of the North-West Provinces and Oudh, the area served by them, the cost of irrigating from them, etc. The outcome of these professional enquiries, together with a report on experimental wells in the North-West Provinces and Oudh, tended to shew that well construction by the State on any adequately large scale could not be undertaken with definite prospect of advantage or profit.

It was therefore considered advisable to leave all such utilitarian endeavour to private enterprise, assisted by loans of public money, and guided where necessary by the professional advice of Engineers attached to the Department of Land Records and Agriculture, and the Court of Wards. Sets of dredging apparatus and an ingenious and useful boring tool, perfected by Mr. Wilson, the Departmental Engineer, are reported as having proved most valuable aids to successful and economical well sinking.

Reclamation of usar lands has been attempted without success apparently. The Commissioner of Jhansi is experimenting with a scheme for the reintegration by means of dams to control surface drainage of tracts of country which have been denuded of soil; but of his experiment no particulars are as yet available. Again we are told that the alleged effect of canal water in promoting the spread of *reh* has formed the subject of careful observations and minute special experiment in a number of villages selected for the purpose; and that maps have been drawn up shewing the area and distribution of usar and the depth of the subsoil water level throughout the provinces lately administered by Sir A. Lyall. It seems to us that in such a matter the opinions of a scientific chemist would have been of more use than maps.

Planting trees in the scorched shadeless plains of India is held to be a work of religious merit by Hindoostanees, of practical utility by Europeans. Sir Alfred Lyall's administration is to be credited with 2,000 miles of good works in the way of roadside avenues. Special attention has been paid to profitable disposal of the products of this umbrageousness, and the trees have become a valuable property, receipts in many districts exceeding expenditure. This is an example we should like to see imitated on a good many wasted roadsides in India. We are not told whether the model farm at Cawnpore has paid expenses. We are simply told that it has been "maintained" and a possibly judicious silence is maintained as to its operations. This contrasts unpleasantly though with a statement made a few lines further on in the same paragraph that the Horticultural Gardens at Lucknow continue to be managed with efficiency and economy.

Here is a paragraph, suggestive of the beauty and uses of Free Trade as a shibboleth:—"A careful enquiry into the condition and prospects of tea cultivation in Kumaun, Garhwal, and the Dun, shewed that the industry was in a state of extreme depression, chiefly on account of the cessation of the Central Asian demand, and the restrictions placed by the Chinese Government on trade with Thibet, while Chinese tea is admitted free of duty into India." And yet Indian Governments profess a wish to foster a home demand for tea. With that aim shops

for the sale of tea in leaf and in infusion have been opened under Government patronage at Cawnpore and Lucknow.

Apropos of tea, and its consumption in lieu of more deleterious stimulants, many missionaries, and other well meaning people, make a fuss every now and again about Government's "patronage" of liquor stills and its Excise Systems. Unsophisticated, ingenious people, they say are being encouraged to drink. Unholy profits on the sale of spirituous liquors help to fill Provincial Exchequers, and the wickedness and ill effects on society of this unearned increment they never tire of denouncing. With regard to the North-West provinces and Oudh the blue book now before us declares that although consumption of spirits has considerably increased of late years still the total yearly consumption is by no means absolutely large. It amounts to little more than one pint for each adult male of the population, and about three pints for every adult male of the acknowledged drinking castes. The castes that is to say which take the place of navvies in England. If they never had recourse to stimulants to pull them through their spells of hard work, Engineers in India would find construction of railway lines, and hill roads, and public works of sorts a much more difficult business than they do now. Again, we are told that the officers best qualified to judge testify to marked improvement in the condition of the working-classes within the last few years. And with this improvement comes an occasional treat of the poor man's one luxury. He "likes a drop of good beer," in England; out here he fancies toddy; but whether out here or in the old country human nature is human nature, and will probably so continue to the end of the chapter, all cant, and Phariseisms, and dog in the manger-isms notwithstanding.

During the administrative period under review the central prisons of Bareilly, Benares, and Fatehgarh, have been largely extended and improved. Although no really skilled laborers were withdrawn from intra-mural industries, yet most of the building work was executed by convict labor,—without any of the ill consequences croakers are fond of attributing to such economical, useful, and healthy employment of our prison populations.

We should like to see jail labor more generally utilised in such fashion in India. We note that the restrictions imposed some years ago by the Secretary of State on intra-mural jail industries have recently been relaxed, on condition that injurious competition with private capitalists is avoided—a proviso to which we are glad to find the Government proclaiming that it attaches much importance. It will not be always the easiest thing in the world for jail authorities to avoid competition: still, where there's a will there's a way.

In connection with the subject of urban sanitation the Lyall Retrospect says that projects are "under discussion" for the better water-supply of the large towns of Allahabad, Agra, Lucknow, and Benares. As to village sanitation it is written that "the difficulties in the way of practical reform are very great." They are great

just because in dealing with them and their authors Government "makes believe," as our nursery folk say, to be dealing with sensible men, and not with grown up children. Perhaps when qualified women doctors are spread all over the country there will be reform in this direction. Two European lady doctors have recently been attached to the Agra Medical School to instruct the female subjects in special subjects and a woman's hospital and other needful buildings are under construction from funds supplied by the National Association for supplying female medical aid, supplemented by a grant from Government.

On the whole, the account rendered of Sir Alfred Lyall's five years of office is a record of good work faithfully performed, and a not inconsiderable amount of progress achieved.

MORE TAXES.

IF a candid confession is good for the soul, Mr. Westland must have found some relief in unburdening his mind on the subject of Indian finances. It is true he has thrown a good deal of light on it, but it is a poor consolation to know that we are not only much worse off in this respect than what was anticipated, but there is not even a glimmering of hope in the near, and for the matter of that in the distant, future. There is a proverb which says "it is darkest before dawn," and another akin to it "that when things come to the worst they must mend;" but the darkness has brooded so long over the monetary affairs of this country, and we have been so long accustomed to the dark side of the question, that we really despair of seeing the daybreak and the clouds roll away. However, it is some comfort to be informed that either there will be a trifling deficit or a small surplus at the close of the coming official year, it is difficult to say which, considering the mass of figures with which Mr. Westland's speech is interlarded. It is once this and at another time that. To go through the labyrinth of accounts would require the patience of Job and we are, therefore, not surprised that not one of our contemporaries has referred to them in detail.

There is one point in connection with Mr. Westland's speech which we would notice before passing on to the subject of this article. He is impatient of criticism. After having administered a severe castigation in print to his critics who accuse the Government of "wanton extravagance," and "whose accusations waste themselves in generalities," instead of confining the charge "to specific items of expenditure which it is considered might with advantage be discontinued," he lashes himself into a fury. It was too much for his nerves to bear the affliction with complacency, and he burst into "with such people I do not care to argue, and the Legislative Council is not the place where such arguments are called for." Human nature is the same all over the world and we will overlook this exhibition of infirmity of temper, even in the Viceregal Chamber. But with the deference due to such an authority in the manipulation of figures, we cannot help observing that if arguments were permitted in the highest council in India,

we would not have the misfortune to witness the spectacle of recurring annual deficits instead of a surplus. It is only because the public is not taken into the confidence of the Government, that we are treated to these repetitions of miscarriage, in making the two extremes meet. There was a lament about the appearance of the lean kine in supersession of the fat kine gone to fresh woods and pastures new, to which Sir Alfred Lyall referred two years ago, when he introduced the Income Tax, but as Mr. Westland truly observes, "he did not then know how terribly lean they were going to be." After passing over these stereotyped forms of expression, which are intended to impart a dramatic effect to the debate in Council, let us see how our accounts are settled for us by the "powers that be."

The Financial Statement of March 1884 contained comparative figures of accounts for the previous ten years, from which we find that the expenditure in the first of the series of years was Rs. 5,74,00,000 and in the last of them Rs. 7,11,00,000, shewing an increase of Rs. 1,37,00,000, or about 24 per cent. In the items of increase are included Railways, extension of Irrigation, and that of Post Offices and Telegraphs. The first-named accounts for Rs. 68,00,000, which means that during the period mentioned above there was an addition of many miles of Railway, and that the Government had to pay a much higher rate of exchange on the remittances required to pay the guaranteed interest. In the same way Irrigation absorbed Rs. 5,00,000, while Post Offices and Telegraphs account for Rs. 6,00,000. But this cannot be said to be a loss as these departments bring in as much revenue as they cost in expenditure. Comparing the figures of 1884-85 with those of the present official year, it is seen that whereas four years ago there was a revenue of 51 millions, of which 48 went on expenditure and 3 in exchange, in 1887 the revenue was enhanced by 3 millions more, making 54 in all, but as exchange costs 5 millions instead of 3, this enhancement really means one million for increase of expenditure. From a tabular statement in the printed address of Mr. Westland it appears that the Railway Revenue Account in 1883-84 was Rs. 80,66,000; in 1884-85 Rs. 76,85,000; and in 1887-88 Rs. 90,02,000; deduct interest, annuities and other charges, the accounts stand as follow for those years: viz., Rs. 72,69,000, Rs. 75,63,000, and Rs. 86,00,000 respectively. Comparing with the financial position of 1884-85 the Budget estimates of 1887-88, notwithstanding the increase in railway earnings, which was scarcely at a pace to cover the charges on account of interest and annuities, and also taking into consideration the heavy exchange, it more than absorbs all the increased earnings. For Imperial Public Works the ordinary standard is, Rs. 10,00,000 for Military Works, and Rs. 3,50,000 for Civil Works, but the Budget estimates of last year shew an addition of Rs. 4,80,000 for Upper Burma and Rs. 2,00,000 for the construction of Military Roads in the North-West frontier.

Since then an additional strain has been placed upon the Revenue, and that is the Exchange, the nightmare of Financiers all over the civilized world. It has

perplexed the greatest of political economists, and small wonder that it should form a stumbling-block in the way of all improvements in India. How unstable and shifting it has been will appear from the following, although we claim no originality in working out the figures. The estimate of 1887-88 was taken at 17½ pence. Since then it has been as low as 16 pence, but it once more regained its place and even partially improved, standing at over 18 pence in the beginning of February last year. Instead of going through the labyrinths and mazes of the fluctuations, suffice it to say that Mr. Westland estimates the exchange at just under 17 pence. The present home expenditure is close upon £14,500,000; demands for military works and interest on the capital of the aided Railway Companies have added half a million to the standard of 1884-85, and the difference upon the expenditure varying between 17.5 pence and 16.9 pence is Rs. 7,20,000. The old complaint that the Government Railways have not been doing well is repeated. The receipts under this head are controlled by the state of the crops in America and in Russia and the state of prices in England. Accepting this view, the results of the year shew that the Budget Estimate was based on a view too sanguine for existing facts. Mr. Westland says: We deal with huge figures under this head, for the gross earnings of the Railways which are paid into the Indian Treasury have recently been as follows:—

Actuals	...	1884-85	...	Rs. 1,59,58,615
"	...	1885-86	...	" 1,76,99,747
"	...	1886-87	...	" 1,81,09,537
Budget Estimate, 1887-88	...		...	" 1,84,28,770

The active Railway season comes at the end of the financial year, and it is quite possible that we may witness a partial recovery before the year's account is closed; but as matters at present stand, our estimate is that the net result of the Railway account, even after allowing for the reduction of working expenses, which becomes possible in a time of smaller earnings, may be Rs. 4,00,000 worse than in the Budget Estimates; and seeing the large amount of unremunerative capital expenditure that is going on, we should not reckon on any immediate improvement bringing in more than will cover the additional interest charges.

One word more on the subject of legislation and we have done. Since 1871-72 the consumption of salt in thousands of maunds has risen from 22,280 to 31,633, or an average of 30,820, in other words a duty averaging Rs. 60,03,000. As regards imports of Mineral Oils, in 1873-74 they were valued at Rs. 3.51 lakhs, whereas in 1886-87 they were 31,949,633 gallons valued at Rs. 125.99 lakhs, and in the eight months of 1887-88 they were 20,817,770 gallons valued at Rs. 80.51 lakhs. Deducing from the import this year that it has been slightly in advance of last year the probable annual import is estimated at the value of 130 lakhs, on which a 5 per cent. duty will give an income of 6½ lakhs. It is a moot point whether the duty might not have been raised still higher without appreciably interfering with the general use of Mineral Oils.

Notes and Comments.

THE RECENT SNOW-STORM AT QUETTA.—During the recent severe snow-storm in the Quetta district, a native contractor and his two servants were frozen to death at Gandak.

WORKMEN FOR AFGHANISTAN.—Mr. Thomas Salter Pyne, M.I.M.E., the Superintendent of His Highness the Amir's workshops, is in London in search of skilled artisans to proceed to Kabul.

DARJEELING-HIMALAYAN RAILWAY.—The Directors of this Company have declared an Interim Dividend of 4 per cent., being at the rate of 8 per cent. per annum for the half-year ended 31st December.

MADRAS FINE ARTS EXHIBITION.—Among the List of Prizes offered for competition at the Exhibition to be held this month are two for Architectural and Decorative Designs of the value of Rs. 50 each given by the Society.

TERRIBLE ACCIDENT AT DELHI.—During a funeral ceremony at Delhi, a balcony, in which a large number of people had assembled, came down with a crash, and seven women, six men, and three children were killed, and some thirty persons injured.

WEST DECCAN RAILWAYS.—The ceremony of uniting the Portuguese West of India Railway with the Southern Mahratta was duly performed on the frontier last week by the Viceroy of Goa on the one part, and the Governor of Bombay on the other.

PUNJAB P. W. D. CANAL OFFICERS' TEST.—The following officers of the Irrigation Department have been declared to have passed with credit the examination prescribed for Canal Officers:—Mr. J. Farrant, Executive Engineer; Rai Bahadur Balmokand, Executive Engineer.

HOW MUCH THEY KNOW OF INDIA.—A Correspondent writes: Having occasion the other day to require a copy of a leading Engineering journal published in London, purporting to have Agents in Calcutta, I referred to the latter and found them *non est*—the firm having gone into liquidation some years ago!

GOPALPUR PIER.—Since no Public Works Officer is available to supervise and check the work of the Contractor, it has been decided, on the proposal of the Superintending Engineer, to entrust the Port Officer with the duty of keeping a record in connection with the screwing of the piles of the Gopalpur pier.

FLOATING PLANT—KISTNA DELTA.—The cost of maintaining the floating plant of the Kistna delta during the ensuing year is estimated to amount to Rs. 14,822, or Rs. 1,015 more than that of the current year. This plant consists of 1 steamers, 8 dredger, a large number of iron and wooden punts, besides village ferry "dug-outs."

A GOOD SELECTION.—Major Hector Tulloch, R.E., has been appointed Chief Engineer of the Local Government Board, in succession to Sir Robert Rawlinson, K.C.B. Major Tulloch has been for many years one of the Engineering Inspectors of the Board, and was previously engaged on extensive public works in India.

A VALUABLE PRECEDENT.—The Board of Directors of the Madras Railway Company have authorised the grant of a bonus of Rs. 4,000 to Mr. E. W. Stoney, one of their Engineers, in consideration of the monetary and other advantages derived by the Company by the use of his patent inventions, *viz.*, excavator, under cutter, &c.

BURRAKUR IRON WORKS.—We are informed, with reference to our recent paragraph on these works, that they

are now carrying out a large order, at the rate of 10,000 per mensem, of D.-O. sleepers for the E. I. R., and that the same pattern sleepers previously made by them for the Cawnpore-Jhansi Railway have been found a success on that line. Nevertheless, we should prefer seeing Government out of its present anomalous position in this connection.

RAILWAY ACCIDENT ON THE E. I. R.—It is a significant fact that the half-yearly and annual inspection special of the E. I. R. authorities, on arriving at the Dildarnagar station, the engine and two of the attached carriages, while moving over to the main line got derailed. Fortunately no one was injured, and though immediate measures were adopted to clear the block, the result was that the mails and passengers were delayed.

ROOM FOR REDUCTION.—The Government of India has recently remarked that the number of hands employed in the office of the Examiner of P. W. Accounts was very great and that a large percentage of them were in receipt of high salaries. In reply it has been stated that while it is practically impossible to work the office efficiently with a smaller number of hands, every endeavor will be made to gradually absorb the higher grades of Accountants.

MADRAS JAILS.—The total cash earnings of convicts in the Madras jails during the year 1885 amounted to Rs. 31,861-5-0 only, and the average cash earnings per head of average strength to Rs. 3-14-0; the average net earnings over India per head of average were for the same period Rs. 15-2-3. The Madras average cash earnings were smaller than anywhere else in India, while the average gross cost of maintaining and guarding prisoners was higher than anywhere except Coorg.

IRON-FRAMED HUT-BARRACK.—The question of introducing a type of iron-framed hut-barrack equally suitable for use in the Hills over an elevation of 4,000 feet, or in the Plains during the winter, for hatted camps, forms a new departure in connection with barracks for the British Soldier in India, as it will, to a large extent, obviate the necessity for building any further permanent barracks of the present expensive type. The structural details of the design adopted are of the simplest character and call for no special remark.

MADRAS COLLEGE OF ENGINEERING.—The Secretary of State having accorded his sanction to the constitution of two new Professorships—one of Engineering and one of Mathematics—in connection with the re-organization of the teaching staff of the College of Engineering, Madras, His Lordship has been requested by Government to arrange that the two Professors may arrive in this country from England towards the end of June, so as to be ready for the opening of the College on the 1st August. The new building is expected to be ready for occupation by the end of May.

RAILWAY GAUGES IN ASIA.—In British India about two-thirds of the total mileage are laid with the 5ft.-6in. gauge and the balance in five different gauges, varying from 2 to 4ft., the longer mileage being represented by the 3ft. 3½in. gauge. On the Island of Ceylon it is 5ft. 6in. The Russian Trans-Caucasian railways have adopted the Russian standard, 5ft. On the Island of Java 3ft. 6in. gauge is adopted on about four-fifths and 4ft. 8½in. on the balance of the total mileage. In Japan the 3ft. 6in. gauge has been adopted on all lines with one single exception.

THE YELLOW RIVER.—Our Correspondent in China writes:—This subject is such an important one that I confess myself unable to do justice to it. The several articles which have appeared in the general press, are the contributions of people who have seen but very little of the mighty stream they write about. I have crossed and recrossed it many times at different seasons of the year, and in many different places. I have sailed on its waters, and have assisted at the repairing of its embankments, and certainly know a good deal about the matter, but I lack the descriptive power which the subject demands.

ROAD MAINTENANCE IN CENTRAL INDIA.—The Government of India in the Public Works Department has issued orders to abolish the offices of the Superintending Engineers and Examiner of Accounts in Central India. The roads which have been hitherto maintained from the Imperial funds will be made over to the different Native States, which in future will be expected to keep them in an efficient state of repair. Sir Lepel Griffin, it is said, considers such a step a political blunder, and has very strongly protested against the transfer of roads and buildings to the Native States, and those in British territory to the Rajputana administration.

ANOTHER TEMPEST IN THE MADRAS HARBOUR.—Thirteen months ago the Trustees of the Madras Harbour objected to the employment of Mr. Parkes as Engineer-in-Chief or as Agent to the Trust on a fixed salary of £500 per annum, and protested against the payment in question being debited to the accounts of the Harbour. But as Government have paid no attention to this protest, it has been decided to point out to them that as Mr. Parkes has ceased to be Engineer-in-Chief to the Madras Harbour Works, and is now simply the Consulting Engineer to the Secretary of State, the question of his salary should be reconsidered and the amount reduced.

CHENAB BRIDGE.—Mr. J. R. Bell, Engineer-in-Chief—a recent appointment—has revised the estimate for the construction of this Bridge, and his proposal, which is now before the Government, shews that a considerable saving can be effected—to an extent of not less than 10 lakhs, by the adoption of a nine span instead of a twenty span bridge as originally devised. He has represented to the Government that his proposal will not interfere with the stability of the bridge. The Brick contract for the bridge has already been granted to a Scindhi of Sukker for Rs. 1,00,000, and it is confidently expected that the work on the bridge will commence in September next. At present a small Office Staff carry on the duties of the Office.

AN ITEM FROM BURMA.—The progress on the Toun-goo-Mandalay Railway has been much retarded by delay on the part of the India Office to supply vehicles, which, according to contract, should have been delivered at Rangoon in December 1887. The Manager and Engineer-in-Chief, trusting to the India Office, transferred a large number of ballast and timber trucks from the open line to construction works, resulting in a loss of revenue to the open line, and much inconvenience to merchants and timber traders, as well as delay in construction of the extension to Mandalay, as there are not even sufficient vehicles for satisfactory progress. We scarcely think, however, that the India Office is as much to blame in this matter as some people try to make out.

THE NIZAM'S RAILWAYS.—The new lines are being completed at a remarkably low rate of cost, the estimate

exclusive of rolling-stock, amounting to only £3,943 per mile: "a price," the Chief Engineer adds, "at which I may confidently assert no broad gauge lines in India have yet been completed." The original line from Wadi to Hyderabad cost Rs. 1,75,585 per mile with rolling-stock. It is difficult to understand how this great difference in the cost of constructing the two divisions of the line has been brought about. The Company is said to have had "disappointing difficulties to overcome" and yet the Chief Engineer is able to report "a saving on the original estimates of the cost of construction of the whole line from Secunderabad to the frontier of about £92,000."

SURVEY OPERATIONS IN THE BOMBAY PRESIDENCY, 1886-87.—The great Trigonometrical Survey of India was considerably advanced during the year. The total area topographically surveyed during the year was 3,245 square miles. The survey parties employed in the Deccan and Cutch in 1885-86 were employed elsewhere during the year. The operations of the Revenue Survey Department in the Presidency Proper resulted in an increase both in the area measured and classed as compared with the results of the preceding year. Except in the Ratnagiri and Southern Maharatta Country surveys revision work was chiefly done. Progress was made with the original survey in the Ratnagiri and Kanara Districts.

TRAINING OF NATIVE ENGINEERS IN ENGLAND.—A contemporary says:—One of the schemes initiated by Lord Ripon for the regeneration of India was a project for sending annually to England two native Engineers, who would draw full Indian pay during their absence, and receive a professional training in England at the public expense. Last week's *Gazette of India* contains a Resolution of the Government of India on the barren negative results of this generous experiment. Practically, then, the experiment having failed, the scheme may be considered to have fallen to the ground, a consummation which in these days of financial pressure is not without its compensations. The purport of the Resolution is given elsewhere.

INSPIRED OPINIONS.—It has been said that, in days gone by, doctors have prescribed for patients without making the usual professional visit; and statesmen, of Mr. Gladstone's type, have not scrupled to legislate for a country they have never visited, and a people they know almost nothing about. It has, however, fallen to the lot of Mr. Shelford, C.E., Member of the Council of the Institute of Civil Engineers of London, to design the development of the resources of a, to him, unknown country. Mr. Shelford has never visited the island of Ceylon, nor come in contact with any member of that Colonial Government or other responsible official; yet he has designed an elaborate, though useless, system of narrow gauge railway lines for Ceylon, and the residents of the island are justly indignant.

THE TELEGRAPH DEPARTMENT.—We understand that the Defence Committee of the unfortunate Telegraph Department has given expression to the universal feeling of dissatisfaction with which their fellow-sufferers are animated, and have formally condemned the recent re-organization scheme as inoperative for good, and cruel in detail. The Committee notes that the chief defects of the retirement portion of the scheme are:—1st—that no real facilities for retiring are granted to officers "appointed in India;" 2nd—that no provision is made for allow-

ing officers with furlough due to avail themselves of it before sending in their papers; and lastly—that officers who have already nearly qualified for a Rs. 4,000 pension are not to be allowed to put in the few months necessary for the purpose.

CALCUTTA IMPROVEMENT.—As already announced, Calcutta is to be improved by the construction of a new Central Road from Howrah Bridge to Sealdah Station. The width of this road will be at least 70 feet throughout. It may be stated that the average proposed width of Cornwallis Street is 63½ feet, of Amherst Street 61 feet, of Cross Street 20 feet and of Cotton Street 17½ feet. The estimated cost of the entire land to be acquired for the Central Road is Rs. 34,50,000, and the amount to be realised by the re-sale of the surplus land is set down at Rs. 24,30,000, on the assumption that the value of the land will be enhanced forty per cent. The net cost of the project is estimated at fifteen lakhs, including two lakhs for the construction of the road itself, besides sewers, footpaths, &c. The estimate for surplus land is based upon the assessed value of the houses and lands through which the road will pass, an increase of fifteen per cent. being added as statutory compensation.

TRANS-CASPIAN RAILWAY.—Various contrivances were devised to protect the new line in Central Asia from sand drifts, two of which are worth mention. It was found that, if the sand was sprinkled with salt water, the rapid evaporation produced a strong crust, which prevented any movement. Secondly, it was observed that in many places, there rose in the sands little eminences, which, even in a slight wind, "seemed to smoke." By covering these over, drifts were almost entirely prevented, as the lower level was not touched by the wind. The difficulties arising from want of water are regarded as no longer existent. The question of fuel for the locomotives was easily solved, likewise the heating of dwelling-houses—an important consideration during the long winter months. The use of naphtha as fuel has this secondary good result—that it prevents the inhabitants from cutting down trees for fuel, the inevitable result of which is to expose the country thus stripped of vegetation to drifts of sand.

THE CALCUTTA PORT COMMISSION.—From a resolution on the Administration Report of the Calcutta Port Commissioners for the past official year it appears that the consolidated debt owing to Government has been reduced by a little more than a lakh of rupees. The Commissioners received from Government further advances to the extent of 31 lakhs for the construction of the Kidderpore Docks. The total amount of debt is one crore, and three-quarters, and the assets two crores 59 lakhs. The income during the year, exclusive of the opening balance, was 23 lakhs, and the total expenditure nearly 28 lakhs. The total amount of receipts from inland vessels wharves was about four-and-a-half lakhs. The income of the Harbour Master's department was nearly 6 lakhs, and the expenditure 5 lakhs. Eight vessels met with accidents whilst in charge of assistant harbour masters, but sustained no serious damage. The number of vessels surveyed during the year for hull and engineering certificates was 265. The receipts from the Port Commissioners' railway were nearly two lakhs of rupees.

SEEBPORE ENGINEERING COLLEGE.—The College Sessions of the Apprentice Department commenced on the 6th instant. The following is the result of the Annual Ex-

aminations held in the College on the 20th January and following days:—From the 1st year—26 students appeared, of whom only 22 were promoted, including three students conditionally. From the 2nd year—16 students appeared, of whom 13 students only were promoted, including three conditionally. From the 3rd year—24 students appeared, of whom only 19 students obtained promotion, including three conditionally. In summing up: out of 66 students only 54 have obtained promotion, which appears to be at the rate of 68 per cent, deducting those who passed conditionally. We hear that the results of this year are quite unsatisfactory and below the average. With regard to the in-coming students 47 appeared for the Examination, of whom 37 students have passed. It is uncertain as to how many *will* join College, for the medical test of physical fitness has yet to be undergone.

BANGALORE WATER-SUPPLY.—We endorse the view of a local paper anent the invidious vote of Rs. 500 to General Fisher to enable him to formulate a scheme while the Madras Government is calling for tenders for like projects with the same object. It says: We are surprised that the possibilities of a hasty vote of money—small comparatively as the vote was—were overlooked by those who supported it. There is every reason to believe that other schemes are in course of preparation: we all know that the Madras Government expect such schemes to be submitted to them. Is the Municipality prepared to spend Rs. 500 upon every scheme sent in to the Madras Government? If not, why not? Why should one scheme be favored more than others? By this vote the Municipality has committed itself to a principle of helping every candidate to test his own ideas; for logically and fairly it cannot make fish of General Brown, R.E., flesh of Colonel Jones, R.E., and nothing at all of Captain Robinson, R.E. The Municipality has established a precedent that may be found most inconvenient and expensive.

THE SPECIAL LEAVE DODGE.—The following case is a fairly good instance of the way in which the Government will condescend to get the better of its servants. To a certain large branch of a large department it was recently announced that Government out of its great goodness and bounty was prepared to allow a certain number of special leaves, as a set-off to the general badness of the times, in excess of the sanctioned number of furloughs. The chance was at once seized by several men; but when those eligible for furlough applied it was discovered that the full number of absences could not be sanctioned; that is to say, furlough and specials together were only to be equal to the ordinary number of furloughs. And now the snare appears. The special leaves carry no officiating promotions as the furloughs would do, and thus by substituting the former for the latter instead of adding them on, the supposed indulgence turns out to be merely a means of snatching a furtive economy at the expense of the unfortunate juniors, whose very badness of prospects was the alleged motive for the innovation.

AN EXTRAVAGANT EXPERIMENT.—About 8 months ago Saxby and Farmer's interlocking signalling apparatus were introduced by Mr. Thomas, Loco. Superintendent, at the Insein station of the Burma State Railway. It was to have only cost Rs. 3,000; but when landed at Insein this figure rose to Rs. 6,000; and after erection it became Rs. 9,000; and about Rs. 2,000 for repairs, make it in all Rs. 11,000. It was

erected under the Loco. Superintendent's supervision in a most *kutchu* manner, without proper foundation, &c., and the levers instead of being in a raised lever box, so as to command a distinct view of all points and signals, were placed among shrubs under the verandah of the station building. Every time three trains are in the station a man has to be sent to the other side of the line to make signals to the station-master working the levers as to how he is to work them, for he can see no signals from where the levers are worked. The signals and points are always out of order and continually give trouble as well as cause delay to trains. It is understood that the Traffic Superintendent has condemned this apparatus as at present erected and considers it a failure.

THE IRON SCREW-PILE JETTY AT MALACCA.—We have been kindly favored with the subjoined particulars regarding the new Pier, now about to be erected:—It will be 1,190ft. long by 10ft. wide, except at four places equidistant from each other along its length, two of which are the head and midway landings. At these four places it will be 30ft. wide for distances of 20ft. The landings will be roofed with corrugated iron roofing over iron framing, supported on ornamental cast-iron columns, and will be provided with strong wooden ladders on each side. The first 150ft. of this structure, long since built, is borne on stone piers. Beyond that it is to be on solid wrought iron piles braced and strutted throughout except in some bays to allow of the passage of boats under it. The decking or flooring and the roadway beams under it are to be of timber like the finished portion. The railings throughout will be of gas tubing fixed in cast-iron standards bolted down to the floor. The Pier is expected to be completed by the end of October, and to cost \$37,000. The iron work was supplied by Messrs. Westwood, Baillie & Co., of London, through the Crown Agents, and is being erected under contract by Messrs. Riley, Hargreaves & Co., of Singapore.

RAILWAY AND PUBLIC WORKS ADVERTISEMENTS.—The *Civil and Military Gazette* says:—We have received more than one complaint from native contractors, that the Railways and the P. W. D. waste Government money in making contracts. This, of course, is not the gravamen of the contractors' complaint: what they—except a favored few—object to is the limited competition for contracts owing to the negligence of the P. W. D. in advertising their contracts. One disappointed contractor, in a letter received this morning, writes, for instance, that he often looks in vain through our advertisement columns for invitations for tenders, and then hears suddenly that some favored rival has got the contract without competition. This, if correct, is obviously not as it should be, from every point of view—whether of contractor, Railway, Government, or tax-payer. No doubt competition for contracts is in this country often a sham and a delusion owing to previous agreements arrived at by rival contractors. As commercial activity spreads, however, this drawback will be remedied; and, meanwhile, the best plan to foster commercial activity is to widen the circle of competition for Government contracts. This can only be done by advertising; and Government should see to it that no contracts for the P. W. D. or State Railways be assigned except to the most favorable tenders in open competition. Such a system would be more honest and profitable—to the State and the public—than the hole-and-corner system of private applications for favors.

Current News.

THE Commander-in-Chief inspected the Government factories at Cawnpore last week.

It is hoped to complete the line connecting Bilaspur with Nagpur in about a year and-a-half.

THE authorities in Burma are preparing an exhaustive report on all the earth-oil fields in the province for the India Office.

LIEUTENANT G. M. DUFF, Royal Engineers, at present serving in Upper Burma, is to be transferred from the Madras to the Bengal establishment.

THE Rangoon Municipal Engineer invites:—Tenders for the supply of 36,000 gallons, more or less, of Devoe's No. 1 American Kerosine oil for town lighting.

THE weather in Kashmir is very cold and stormy, with continued rain, river overflowing, and part of the bridge of boats across the Tavee carried away.

THE price of ice is one anna per lb. on large orders of 100 lbs and upwards at a time at Thayetmyo: but small orders are subject to the usual rate of six pice per lb.

THE post of Deputy Superintendent of Forest Surveys has been abolished, and Mr. W. H. Reynolds has been appointed permanent Superintendent of Forest Surveys.

MR. J. ELIOT, Meteorological Reporter to the Government of India, is, according to an Allahabad paper, about to visit Madras to inquire into the system of storm warnings at this port.

THE North-Western Railway is said to be working under difficulties owing to the great dissatisfaction prevailing among the staff because of the proposal to abolish frontier allowances from April next. It is feared that a general strike may result.

MR. CROSTHWAITE left Mandalay on tour to the south-east, going over the line of the Mandalay-Toungoo railway, which is reported to be making rapid progress. Sir George White is travelling Shan-wards to Fort Stedman and the hills beyond it.

A LONDON telegram states that tenders have been invited for debentures amounting to one million pounds, bearing interest at $3\frac{1}{2}$ per cent. of the Bengal-Nagpur Railway. The total amount of tenders came to £3,800,000. Tenders at $100\frac{1}{2}$ will receive 47 per cent. above that rate in full.

COLONEL W. G. CUMMING, R.E., Superintending Engineer, went to Maulmain to inspect that division and in company with Mr. Rigg will inspect the Thatone and Dooyinzeik Railway belonging to Mr. G. Dawson who wants, we hear, a concession from Government to extend the line.

ON arrival in India, the undermentioned Officers of Royal Engineers are attached to the Military Works Department, and posted as follows:—Lieutenants G. P. Lenox-Conyngham and R. E. Tomlin to the Rawul Pindi Command. Lieutenant G. A. Travers to the Sirhind and Lahore Command.

OWING to the losses sustained by No. 2 Company, Bengal Sappers and Miners, in Upper Burma, and its present bad state of health, it has been decided to bring it back to regimental headquarters, Roorkee, in the month of April. The No. 5 Company, Queen's Own Sappers and Miners, now at Bangalore, has been selected for service in Burma.

THE report of the Burrakur Coal Company for the half-year ended 30th November discloses a profit of Rs. 20,556, and, adding the balance brought forward, the amount at credit of profit and loss is Rs. 25,886. A dividend of 15 per cent is recommended—this will exhaust Rs. 22,500 and make 25 per cent. for the year, leaving Rs. 3,386 to be carried forward.

UNDER Government orders the transfer of the working of the Bhopal State Railway from the Great Indian Peninsula to the Indian Midland has been postponed for the present, presumably because the Indian Midland is not yet far enough advanced westwards to be able to conveniently take it up. The East Indian Railway classification of goods has under orders of the Government been adopted by the Indian Midland line.

THE report of the Managing Agents of the Alipore Coal Company for the year ended 30th November discloses a profit on the colliery revenue account of Rs. 64,272 and a loss on the zemindari revenue account of Rs. 3,936, and after taking into account interest, depreciation (Rs. 23,414) and commission, the net result is a profit of Rs. 22,060, which wipes out the debit balance of last year, and leaves Rs. 13,371 at credit. A dividend of 5 per cent. is to be paid.

SOME time ago the sanction of Government was obtained to the construction of the Gambila and Kurrum Bridges on the Frontier Railway lines, and the necessary bridge materials for the same were obtained from Karachi. The projected Gambila bridge has stood the test of the second inspection; but the construction of the Kurrum bridge on the selected site has been vetoed on account of the shifty sandy soil of the banks. The Secretary and Under-Secretary to Government in the Public Works Department are now on tour in that locality for the purpose of deciding this question, and of determining how else to meet the difficulty.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.

"AN ENGINEERS' LIBRARY."

SIR,—I was glad to see in your issue of the 28th January that it is contemplated to form an Engineering Library at Calcutta. I trust that we poor Mofussilites may not be left out in the cold altogether, and that a circulating library and magazine club may form a portion of the scheme. This should contain all the current Engineering journals in English, French, German, and Italian. I advertised a short time ago for Engineers to join me and form an Engineering magazine club for a limited number of subscribers, but received only one reply in response. I now hope that this will be done for us by the enterprising members of the profession or firms in the City of Palaces whose "Moment of Inertia" is not so strongly developed as with us Mofussilites.

W. G. BLIGH.

HOLLOW ARCHED ROOFS.

SIR,—The idea proposed by your correspondent with the strange *nom de plume* of "No-Sam" of hollow arched roofs is an excellent one. But his particular design, as he himself admits, is too expensive to be practically useful. Each ring is quite separate and consequently each would have to be of the *minimum* required thickness; so for a 20 feet span each ring would have to be 9 inches thick—thus nearly doubling the cost. Now if the two were joined together at intervals the hollow roof need not have any more material than a solid one in fact would do with less and be much stronger. This system was illustrated in the series of New Types of Cheap Roofs which appeared some months ago in this Journal, but it could be further improved by using bricks of a special size. Thus the rough headers could be 12 inches long and the stretchers made 3 inches wide and thin in proportion. This would provide an air space of 6 inches.

W. G. BLIGH.

HARDEST CASES.

SIR,—In your issue of 21st January 1888 a "Harder Case" is noted, but it is nothing compared to frequent ones happening in Northern India. Let anyone cast his eyes over the classified lists of the Punjab D. P. W., especially the Irrigation Branch, for the last few years, and therein will be found names of Subordinates of long standing, tried and qualified men, sent adrift, whose only fault was nearly dying in the jungle through sheer hard work; and when they wanted a change, they were dismissed, all the "big folks" concurring with one another, and the unfortunate Sub's explanation and demand for justice being only so much waste paper.

Extremely hard cases have occurred, and there being no independent journal in the country till INDIAN ENGINEERING appeared, no notice of such a paltry thing as a European Sub being dismissed and cast to the winds without cause would be noticed. Had these men been natives, the native press would have taken up their cases and Government would have been chary about them, but, hitherto, journalistic work was always connected with Government, and the Subs could get no hearing. For months after the starting of your paper many Subs were under the impression that it would be a party organ for a certain class—a surmise now seemingly unfounded. Hence a Sub to whom I sent your prospectus would not subscribe on above grounds, and told me my Rs. 12 would go for nothing. So heavily trodden upon, are some of the Subs, that they have lost all hopes even in the journalistic enterprises of this autocratically ruled country.

January 26, 1888.

SUB.

SEEBPORE ENGINEERING COLLEGE.

SIR,—Mr. Spring, who in your last issue takes credit to himself for having taken the most active part in the deliberations of the Committee for the re-organisation of the Seebpore College, does not, however, tell us what his proposals are whereby he hopes to improve the status and usefulness of the College. But whatever they are, there can be no question that the existing state of affairs is deplorable to a degree, and the College sadly stands in need of being remodelled on some such lines as would meet with the approval of the Profession in the country. Loud and incessant have been the cries of complaint with which the *alumni* have for the past decade filled the air for want of work, and pertinacious has been the pertinacity with which the arts of self-help have been recommended them by self-wise men who conveniently forget that boys just let loose from within the four walls of a college possess but little stock-in-trade to go forth into the world and successfully chalk out new and profitable careers for themselves. They need to be engaged in professional practice for years in that vast school of engineering in this country—the Public Works Department, before they can be of any use to the Profession or to themselves. The chief difficulty in the way of the passed students of the Seebpore College obtaining a foot-hold in the P. W. Dept. is not so much their inability or unfitness to hold responsible positions, as the unwillingness on the

part of the Profession in that Dept. to tolerate Engineers "made" by Messrs. Dawning and Slater after their own fashion, assisted by, who do you think? Pundit Mohesh Chunder Nayaratna, a Sanskritist, and Bahoo Koonja Lal Banerjee, an *ex-judge*, and such other members of the Board of Visitors!

Could absurdity go any further? I would therefore suggest that the Seebpore College be dissociated as far as possible from the Education Department, and its chief supervision and control vested in a strong committee of the P. W. D. officials, headed by the Chief Engineer and Secretary, as *ex-officio* President, in whose good will and co-operation must lie, to a great extent, the welfare and prosperity of the College.

SEEBPORE COLLEGE.

February 5, 1888.

DEODAR VERSUS STEEL SLEEPERS.

I.

SIR.—Your correspondent "M. I. C. E." contributed an article on "Deodar versus Steel Sleepers" in your last issue. I must confess to being a good deal disappointed after reading it. Coming from an M. I. C. E., I fully expected to find the subject thoroughly discussed in all its *pros* and *cons*, but alas! for my expectations—*parturiunt montes et nascitur*—the whole article is a one-sided affair altogether. First we are told what the essential properties of timber are, (we all know them); then we are cautiously told that deodar possesses them. Therefore deodar is to be preferred. Quite a true syllogism I admit, but deodar does not comprise the whole class of things that possess these qualities; but this is going into Logic, and I will not be irrelevant. However, deodar, we are told, has *strength, stiffness, and durability*, and this is information. We accept it as such, and one more fact is committed to memory; but this is about *all* the valuable information "M. I. C. E." gives. Next he tells us all about *seasoning*, what *heart* wood is, and how timber should be *selected* (all of which our grandmothers knew as well as we do now); but this has nothing to do with the question "Deodar vs. Steel Sleepers" and so can be left out. Lastly we are told that deodar is supposed to be the Cedar of Lebanon. Shades of Solomon! What on earth has this to do with its preference to steel? Solomon may have used it, (and I very much doubt if he would have done so had he known any thing of steel), but still what has this to do with the question in point? Further, the buildings in Kashmir and Jamma Masjid may be built of deodar, but surely, this fact does not give it preference to steel as sleepers? Poor steel sleepers, you have had but scant justice done you by one who ought to know more of you! You are put down as costly; but nothing is said of your *stiffness, hardness, and durability*, which perhaps may more than compensate for your extra cost. No quotation from Science Primers is given in your favor, not even has anything been said of your antiquity (I was going to say *ancestry*)! No royal use of you has been quoted as a brilliant precedent—no, nothing is said but, simply, that you are costly and brittle. You are disposed of in two small paragraphs and in a defamatory way, too.

But to be serious: "M. I. C. E." has been admitted to be one of the lights of the profession: let him, therefore, give us something better in another article, and one that can fairly lay claim to that reward I once saw offered in your columns for the best essay on "Deodar vs. Steel Sleepers" or rather wooden vs. metal ones.

MADGE.

MAULMAIN; January 21, 1888.

II.

SIR.—Incited no doubt by the fact that the Punjab is the best place in India to procure deodar sleepers and possibly by the sporting offer for the best essay, to prove wood better than metal sleepers, made by the manager of a well known forest company, two correspondents, "Blitz" and Rai Bahadur Kunhya Lal, have sent articles to your paper.

"Blitz's" arguments and figures are worthy of attention, but he rather makes the latter fit the former. The representative of metal sleepers is the pressed steel one, which so far only takes the flat footed rail, and it is this type against all others that seems to have the best chance of coming to the front.

The various types in India may be briefly described as follows: Two types of rails, double-headed, subdivided into reversible (with equal heads) and bull-headed (with unequal heads), and flat-footed. The former kinds always require a chair when used with wooden sleepers, the latter kind does not.

Wood sleepers may be of various descriptions but only one type.

The metal sleepers are of two types—the cast iron either pot or flat, and the steel pressed—the combinations being:—

- 1—double-headed rail and cast iron chair on timber sleeper.
- 2—double-headed rail on cast iron sleeper.
- 3—flat-footed rail on timber sleeper.
- 4—flat-footed rail on steel pressed sleeper.

Now, "Blitz" omits any value being given to metal in case of cast iron sleepers broken. He also I think over-estimates the consequences of derailment in case of steel sleepers. The argument of using local productions because they are local is not sound economy. The 20 years age for deodar sleepers I agree with him ought to obtain, but owing to bad maintenance I think 10 years nearer the mark. There is a better class of Permanent Way Inspectors coming to the front (and I hope to see the day when they will be technically educated at one of the many Engineering colleges be-

fore being apprenticed to practical work), but at present a large proportion of wood sleepers are much damaged by, when first laid, spike holes not being properly bored deep enough, and the driven spike knocking off a large splinter at the bottom, and after being in the road the bad use of the beater knocking off the lower edges of the sleeper under the rail seat. A gauger in England lifts the sleeper enough to shovel in the ballast and then packs carefully around and not underneath.

The second correspondent, Rai Bahadur Kunhya Lal, divides his argument into numbered paragraphs which I may here traverse:—

Para 2.—My experience is, that just as little damage is done to steel as to wood sleepers in case of accidents.

Para 3.—If picked material is used the advantage of cheapness fails.

Para 5.—This in short goes to say that good material is to be preferred to bad, which statement does not err on the side of rashness.

Para 6.—A place where it is much more important that knots and other defects should not occur is under the rail seat where the fastenings are driven.

Para 14.—The dhobie test is amusing, and I recommend it to "Blitz" when he has a few thousands to inspect.

Para 15.—As he has not considered the comparative claims of steel sleepers, he is scarcely justified in calmly saying that steel sleepers are costly, brittle and unfit for railway purposes. Finally, I should hardly think that Rai Bahadur Kunhya Lal has had such experience of railway permanent way as to entitle his opinion to carry much weight.

Now I will quote what the President of the Institution of Mechanical Engineers, Mr. Jeremiah Head, speaking at Lincoln 4th August 1885, said in discussing railway sleepers—"Wood sleepers no doubt answer their purpose perfectly as long as they remain sound, but the conditions to which they are subject are extremely unfavourable to endurance—especially under the chairs and the spike holes where endurance is most essential. At these parts moisture is continually entering through capillarity and then evaporating. This active * * * is highly conducive to premature decay" * * * "Considering the growing scarcity of timber all over the world together with the ever increasing need for it, we ought surely to look with jealousy upon its continued use in such enormous quantities for sleepers, when metal would better answer the purpose. It is a form of waste that should be reprehended in the public interest just as should the use of coal for ballasting or any other obviously wasteful purpose. The same timber which becomes useless for sleepers in, say, nine years, would last at least a century in the roof or flooring of a house."

The pressed steel sleeper and two steel keys for simplicity of laying can hardly be improved upon. Its weight with the keys is about 125 lbs. and costs, delivered, say 1,000 miles from sea board, at present Rs 6. It is very tough and will stand any amount of hammering with a sledge. It can be used with either sand or ballast and holds the rail absolutely firmly, and the slotted key if opened cannot work loose. Its life is at present an unknown quantity, as is its behaviour in salt soils, but there is no ground for assuming that mild steel will perish quickly. It is coming largely into use in England as well as India and will, I venture to think, by and bye oust all other kinds. Speaking generally, I prefer cast iron to wood sleepers and steel sleepers to both.

F. R. U.

Literary Notices.

PLANE TRIGONOMETRY. By A. Chaudhuri, B.A., St. John's College, Cambridge; Scholar and M. A. Presidency College, Calcutta. Calcutta: Messrs. S. K. Lahiri & Co. 1888.

THIS book should be welcomed as a praiseworthy attempt of an Indian Graduate, who has had the advantage of other opportunities, to meet the wants of Indian Students in a branch of Elementary Mathematics that has to be debited with a larger proportionate share of examination failures than any other. The get-up of the book is an approximation to Todhunter's larger treatise in respect to typography, but the disposition of the matter and mode of treatment of the subject is somewhat different. If there is any fault at all, it is in the excessiveness of explanation or profusion of illustration, which is rather an advantage than otherwise for a school-book in this country. The chapter on the solution of triangles is particularly good. Geometrical methods as alternate proofs of the more important formulæ are abundant. The examples are numerous, and include selections from both the Cambridge and Calcutta University Examination Papers—the latter including all the L. C. E. Questions from 1869 to 1885. Considering the difficulty of getting Mathematical printing done in India, we must congratulate the enterprising publishers in having secured unusual accuracy and neatness of arrangement in this text-book.

TREATISE ON MOUNTAIN ROADS, LIVE LOADS, AND BRIDGES. By Lieutenant-General H. St. Clair Wilkins, R.E. Bombay : Thacker and Co. 1879.

LIKE the work criticised in a previous number, this book also emanates from the Presidency of Bombay, and is the production of an Engineer Officer in the P. W. D. of high rank.

We stumbled across it quite accidentally some two years ago in an unclassic region. A cursory glance through the pages gave a favorable impression of its contents, and so it was forthwith purchased. A subsequent careful perusal in no way invalidated the previous hastily formed opinion of its value. It is a first-class work of reference, and is worthy of a place in every Engineer's library. It may be out of print now, and probably is; but, if so, we should strongly recommend the enterprising firm of Thacker and Co. to throw off a second edition, which, if properly advertised, would be sure to be taken up. As remarked, the usual Government compilations on Indian Engineering which have appeared from time to time are of the feeblest possible character and a positive discredit to the administration itself, as well as to the exalted P. W. officials who have been told off for the purpose of getting together an olla-podrida of cuttings from various ancient books, pieced up with a few slovenly original articles of doubtful utility.

We quote the last paragraph of the preface, which will explain that "This treatise is not a compilation from the works of other writers. The opinions expressed, and the designs given, are the results of the personal experience of the author"; and a thoroughly practical and useful work it is.

The subject of road construction is a very important one and great stress is now being laid by Government on the subject of feeder roads to lead traffic to the railway stations which yearly multiply all over the country. We cannot do better than to further quote our author, he begins:—"The science of road construction will never become obsolete. Roads not only precede railways, but are required to supplement them; for with the introduction of railways, the demand for local roads increases. Railways therefore tend not to supplant, but to develop roads. This is particularly the case in mountainous countries in which arterial railway lines can only be afforded." Further on he proceeds:—"The subject of the construction of roads has been treated in many Civil Engineering works, but in those treatises of modern date, which have entered most fully into this branch of Engineering science, insufficient space has been allotted for a comprehensive view of the general principles and details, which should be observed in tracing and building mountain roads."

There is another remark of our author's which we will reproduce *in extenso*, as it thoroughly falls in with our own views on these matters:—"It is too much the habit of the present day to regard masonry bridges as bulky, costly, troublesome, slow growing structures, and behind the times. Iron in various forms is preferred as the material to be employed in carrying a roadway over rivers and minor streams. In the author's opinion, an iron bridge should never be erected where a masonry bridge, from the nature of the bridge site, the size of the stream, and the proximity of material, is suitable. In such a case an iron bridge is not the cheapest; it is certainly not the most permanent. A well built solid masonry bridge is a monument, which will outlive many renewals of its slender consumptive neighbour." We commend these remarks to Superintending Engineers, as a reference to the budget estimates of past years clearly shews that further check should be exercised on the propensity discovered by some unexperienced District Engineers and others to go in for iron girders in preference to brick or stone arches. A fact might further be mentioned in support of this statement, that the railway managements at home are already beginning to supplant old iron bridges with masonry structures.

The treatise is divided in 14 chapters, which we shall briefly review.

I.—*Road Reconnoitring*.—No remarks.

II.—*Road Surveying*.—In this chapter our author, who must be admitted to be a little prolix, holds a long discussion on the relative utility of the horizontal and vertical methods with the natural outcome which can be foreseen by anyone who has any real experience in the subject of hill road tracing, that the horizontal is the most practicable method.

III.—*Ordinary Roads*.—This chapter is spun out to rather an unconscionable length. Our author evidently gloats over his work and dwells on unimportant matters too long. He quotes a good deal from Kinnear Clark's book on English roads. A plan of an "Irish Bridge" is given, *i.e.*, earthen inclined cuttings leading down to a masonry platform over the sandy or rocky bed of a stream. This type of construction is always getting out of order, silting up in the slopes, and cutting away also, unless the drainage is carefully arranged for. We much prefer the flood submerged causeway raised a few feet off the bed of stream, which will carry the ordinary current through its openings, and be only impassable in heavy flood. This type of causeway is not even mentioned in the book; with rock the raised is often cheaper than the bed level causeway.

IV.—*Design for a Mountain Road*.—We consider that this subject is also treated in far too prolix a manner. Instead of stating straight off what gradients are required for each kind of traffic, our author gives us tables of traction, of stage wagon and stage coaches at different inclines and different surface materials, rate of travelling, force in lbs., angle θ , sine of angle θ , and so on *ad nauseam*, for some 24 pages. He next has a long discussion on the proper section of road on a gradient, and comes eventually, after another 18 pages of elaborate argument, which might have been condensed into one, to the conclusion that the segmental form with horizontal chord is the best. We venture to differ here, except in the case of parapeted roads. The section adopted by us, and successfully too, was a modification of the inclined straight slope and the horizontal segment. An inner slope is necessary for safety; if no parapet exists it also affords a great sense of security. The chapter concludes with remarks on protection and drainage.

V.—*Instructions on the Survey of a Mountain Road*.—We do not intend to offer remarks on this as space presses and we confess we have not read it.

VI.—*Construction of a Mountain Road*.—This is a valuable chapter full of illustrative plates. Our author builds all his culverts of *pucca lime masonry* and his retaining walls of battered dry masonry. Possibly the laterite and trap rock obtained on the Bombay side is not good enough for dry masonry walling to culverts, but our own practice, in dealing with even sandstone, has been to build every drainage work up to 10 feet span of dry masonry walling exclusively, spanned by stone slabs up to 5 feet span, and above that to adopt one or a series of 10 feet openings, spanned by scrap rails 2 feet apart covered by slabs. In those days probably scrap rails were not obtainable, or their use in bridge work unknown. The double 3 feet openings, shewn in Plate IX., is a very objectionable type of culvert. Owing to the increase of wetted perimeter the value of the hydraulic mean depth R becomes very low, and $4\frac{1}{2}$ feet opening would give an equally good discharge. If slabs 6 feet long cannot be obtainable, one opening of 5 feet should be given, spanned by 23 feet rails cut in four.

VII.—*Of Maintenance of Roads*.—Gives useful information.

VIII.—Gives cost of roads in Bombay.

IX.—*On Road Bridges*.—Is full of intricate calculations, which are of no value, as the easy methods of graphic statics have long ago supplanted the old cumbersome analytical successes.

The rest of the book is on iron and masonry bridges and skew arches. Chapters XI. and XII. on Masonry Bridges are good. The author is ready enough to give an illustration of the Krishna Bridge Inscription in which his name appears on the scroll of fame. Notwithstanding the faults we have pointed out, which are comparatively trivial, the work is a valuable one, as it only errs in excessive diffuseness.

General Articles.

THE PEGU CLUB.

THIS institution had its origin in a private house rented for the purpose, and this accommodation was found sufficient for some years. When owing to the increasing number of members and the general prosperity of the club it was resolved to build a club house suitable to the requirements of the time Mr. H. M. Mathews was requested to prepare a design by the Committee of the Club.

The house is a handsome structure of timber with concrete and tiled basement floor, and is built on an excellent site in the Cantonment along the Prome road.

The accommodation on the ground floor consists of two dressing rooms and two billiard rooms with ample servants' offices.

The upper floor contains a dining hall where sixty members can dine, a large reading room, a committee room and a large half open verandah room, with two halls and more servants' offices.

In the same compound with the Club building are a series of residential chambers for a considerable number of members.

AN APPEAL TO GOVERNMENT IN THE IRRIGATION DEPARTMENT.

BY AN EX-IRRIGATION OFFICER.

II.

BEFORE sketching the outline of this proposed work on Irrigation, it would be as well to state once for all, that any suspicion of amateurism must be sternly repressed. We don't want anything of that sort; there is quite enough of it already in Government professional literature. This must be a really serious business not roughly chucked together anyhow as if intended for the alumni of Rurki College, but a high class work of reference and instruction worthy of a great scientific department.

First, taking up the section on Works, we have observed that the essay must primarily be *critical*. It is no manner of use reproducing old and *passés* types of construction except for the purpose of carefully pointing out their defects, and giving other examples of modern structure, of correct pattern. Again great care must be taken to produce nothing but relevant matter—for instance we do not want plans of canal bridges, details of parapets and so on. This would be waste of power. Anyone can design a canal bridge, but what we do require is that the scope of the work be strictly confined to purely technical matters connected with irrigation works.

The first subject to be dealt with would naturally be Head Works, and all the more important river dams and weirs in Upper India and Madras should be given with a careful description, and notice of any defects which experience may have subsequently brought to light. *2ndly*.—The question of Canals, Falls, Locks, etc., should be taken up, giving only the newest types, or if the ancient Ogee falls are delineated, it would be simply for the purpose of "pointing the moral." Information regarding the discharge of water at all Works should naturally also be noted. *3rdly*.—We come to escapes, distributary head works for passing drainage under and over the canal or level with it, construction of kolabas and so on. This will about complete the first series on Works. The second volume should deal exclusively with that most important subject—the Economical Distribution of Water. In India this is really a comparatively new science. The old Canal Engineers who worked under Sir Proby Cautley, regarded the distribution of water on scientific principles as almost beneath notice. The rajbahas of the old canal were designed anyhow, and their alignment being settled by the rough and ready method of drawing a blue pencil line over a map, was naturally most defective. This is no exaggeration, I myself more than once have seen the process performed by the Superintending Engineer.

In course of time many of the distributaries were found so bad that they had to be rebuilt *ab novo*. The remnant

of the Cautleyites, that is those Engineers who had sat at the feet of Sir Proby, did a terrible amount of damage before they finally retired. The Chief Engineer of those days, a very distinguished Military Officer of most urbane manners, was absolutely wanting in any real knowledge or experience on the subject of irrigation works, and naturally leant upon his Superintending Engineers, one of whom was brought up in the old rough and ready school. Thus after a while the extraordinary spectacle was exhibited of lakhs of rupees being spent on remodelling the old distributaries on scientific principles, while at the same time their very faults were being carefully reproduced on the new canal then under construction! It is needless to add that this ill-designed work had most of it to be realigned and reconstructed. Happily now the old things are passed away and the present irrigation staff, at least in Upper India are thoroughly practised men who have mastered the details of this intricate question. In the old days the supply of water at the head exceeded the demand, and consequently it was allowed to run to waste without much let or hindrance. Now, however, our supply is limited and the area under irrigation enormously increased; hence the greatest possible care and *bandobust* have to be constantly exercised to increase the duty of water. A paper written by a thoroughly competent irrigation officer on this subject would be of incalculable value. Some new canals with their system of distributaries should be taken up *in toto*, diagrams being given shewing the distribution—the area served. A diagram of an actual rajbaha should likewise be given in a similar way with section of waterway at various points, areas and tatil arrangements. The *method* or process of design will thus be explained in detail. Statistics regarding duty of water crops irrigated of recent date should follow. I lay stress on recent, as D'A. Jackson's "Hydraulic Works," a pretentious but hopeless book, is more or less useless from being several years behind date. Finally the details of the working of the department and cognate will close the volume.

Now comes the question—who is to write this work? It is far too heavy a matter to be tackled in odd leisure moments. No; Government must make up their minds to depute two competent and experienced officers on special duty for at least twelve months, and see that the idea is carried out thoroughly.

MAIL STEAMERS AND THEIR SPEEDS.

BY A. EWBANK.

VI.

AN ordinary railway locomotive may be described as a rough-and-tumble machine. It is meant for rough usage. Any delicate or complex additions which would be of service to it were it employed as a stationary engine, are rejected because of their delicacy or complexity.

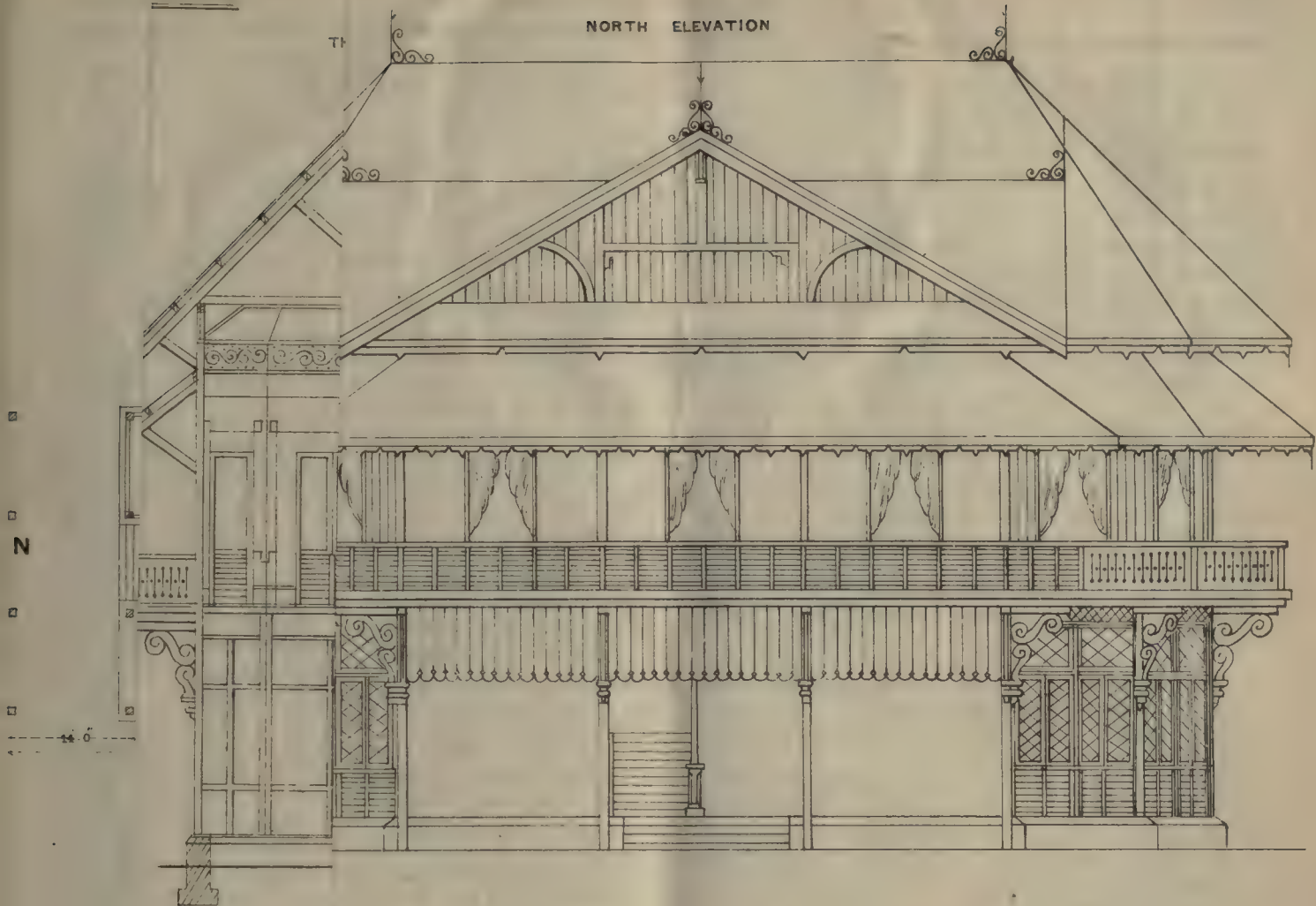
Let the hull of a small ship be supplied with a pair of paddles, each of these having its own independent axis or axle. Let a couple of ordinary railway locomotives be so fixed in the ship that one locomotive may drive one paddle and the other locomotive may drive the other paddle. These paddles can thus rotate in the same direction or in opposite directions. We thus have an effective steamer. The engines are now working as stationary engines—in a fixed material neighbourhood. It may be possible and convenient by certain modifications or by certain additions to improve their economical working. It is no longer an object of prime importance that the whole machine should be kept small. It is no longer a relevant question whether the whole machine can be packed into one case which can run about safely on wheels.

If by certain changes we obtain as much work as before, but at a less expenditure of coal; this implies that more work than before can be obtained with the same expenditure of coal. More work or more power to do work, means greater speed when the mass and volume to be moved are not increased.

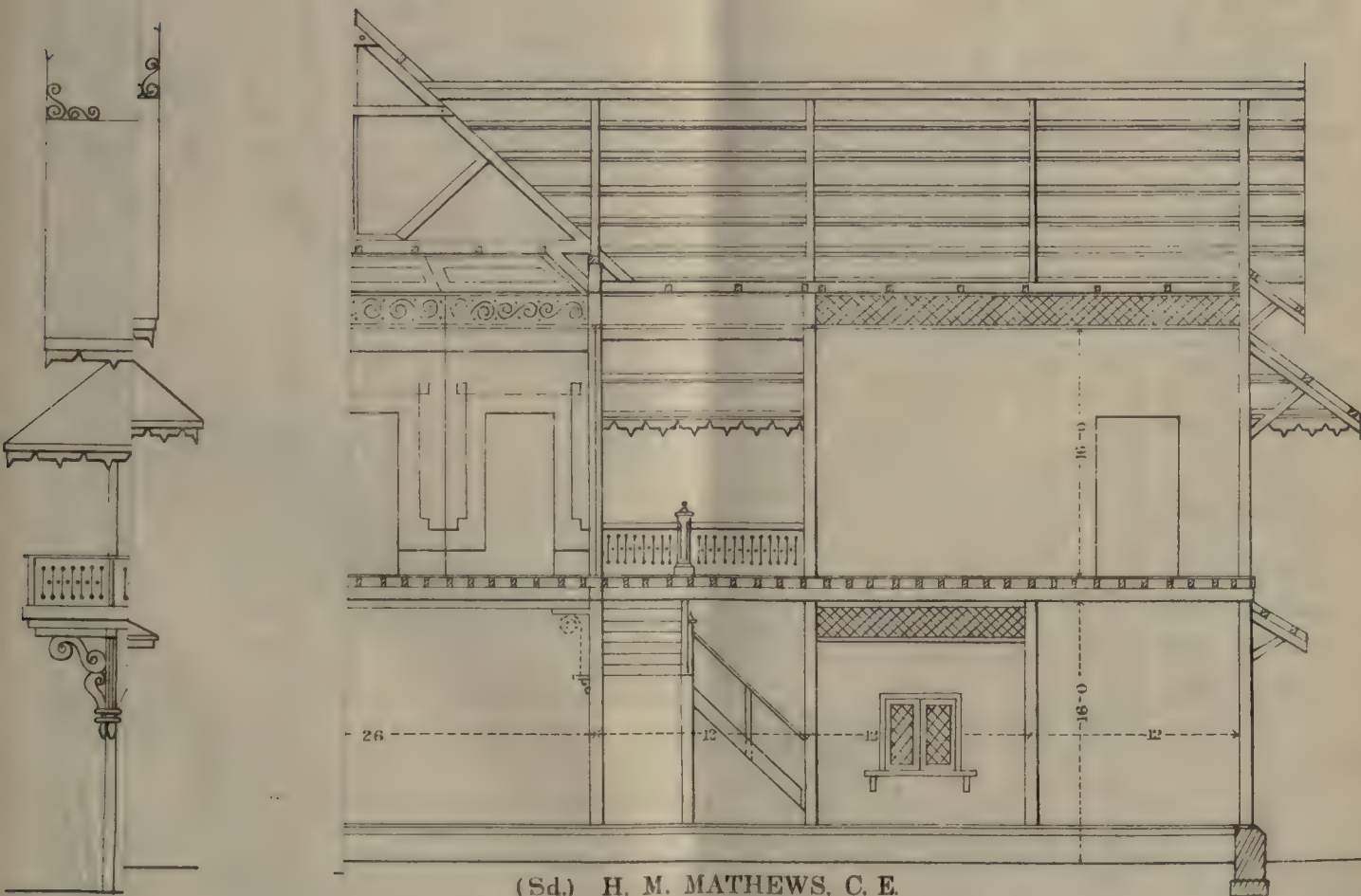
One mode of obtaining more power is to increase the temperature of the boiler steam. In this way one loco-

RING.

NORTH ELEVATION



AL SECTION



(Sd.) H. M. MATHEWS, C. E.

In dealing with *fig. 36* we adopted a mode of proof sometimes called "ad absurdum," sometimes called indirect. A proof is generally considered more elegant when the form of the proof is direct. We can however easily give this form to the demonstration.

Instead of assuming as we first did that *N* lies on *OC* produced, we will leave its position an open question. We may still put $OC = xON$ or $S = xR$ without knowing as yet whether x is greater or less than unity.

Then, as before, if *P* and *Q* give *R*, which $= \frac{S}{x}$ we can replace *P* by xOF along *OK* and xOD along *OC*. Similarly *Q* gives xOG along *OH* and xOE along *OC*. Therefore *P* and *Q* together give $x(OE + OD) = xOC$ along *OC*. Now $OC = xR$. Therefore the forces *P* and *Q* give x^2R along *OC*.

But the forces xOF and xOG destroy each other as they ought to do, and the other components of *P* and *Q* should make up the whole resultant *R* along *OC*. Thus $R = x^2R$ or $x^2 = 1$ or $x = 1$. Therefore the points *N* and *C* coincide, or *OC* is the real resultant.

Here we may bring to a close these discussions on the "Principles of Mechanics." Possibly there are other parts of mechanics or parts of other physical sciences that could with advantage be treated in the full manner in which these elementary questions have been developed.

Meanwhile, to the student of mechanics these articles may perhaps prove a helpful introduction, or the teacher may find in them suggestions for an elementary course to place before his pupils.

JOTTINGS FROM THE N.-W. FRONTIER.

(From a Correspondent.)

Two "Abt Engines" are in course of erection at Sukkur, one of them being nearly ready for the road. The principal features of the engine are four cylinders, two for the main engine placed outside the frame, and two cylinders between the frame to drive the rack gear; the main cylinders are 19, and the rack cylinders 13 inches diameter. The engine is six-wheel, coupled with a pair of small trailing wheels on radial axle boxes. The rack gear is carried on frames hanging from the driving and leading axle boxes—the latter being joined to each other by an iron box over each axle—giving it the appearance, when looked at from above, of a solid axle box from one side to the other. There are two sets of spurs, each of three steel wheels, arranged so that one tooth is in gear, one tooth just entering, and one tooth leaving the rack, they are lubricated with oil from a feeder-box on the foot plate. The rack engine is worked by separate starting gear, and is entirely independent of the main engine, having its own link motion and so forth.

The boilers are huge and have immense fire-boxes, giving one the idea that they are only fed once each trip; these huge fire-boxes are no doubt very necessary. The capacity of the engines is stated to be 200 tons over a grade of one in six! They are fitted with water tanks and coal bunkers. The water capacity is limited to a run of four miles. It is stated that the makers here preferred to build larger water tanks, but the India Office authorities intervened. Water taps and pipes are connected to the steam chest, so that a flow of water is permitted to play on the valve faces when running down hill, the water is run off by two extra cocks on the bottom of the cylinders at command of the driver on the foot plate. The water gauge glasses are fixed on the side of the boiler just behind the dome and are worked off the foot plate by a system of levers.

The driving and trailing coupled wheels are fitted with hand brake gear and wooden brake-blocks, but by a system of levers the top of the exhaust pipe can be closed and a valve opens the bottom, thus permitting the pistons to take in air through the exhaust ports, which, acting on the reserve side of the pistons, form a formidable brake. This system of brake power was extensively used on Continental railways sometime ago. There is a combination of lines and handles about the foot plate, which are viewed with disfavor by the engine-drivers who have been deputed to see the engines erected, and afterwards run them. They are considered to be well finished and were built at Esslingen

A German mechanic came out with the engines and is employed in the erection.

If I have an opportunity of witnessing their performance on the Rack road, I will send you a description on the indicator diagram.

The steamers for the Sind-Saugor have reached the country, and have been erected by Messrs. MacKenzie of Kurrachee, at Kotrie. They are stated to be unsuited for the work between Shere Shah and the west bank. Being about 126 feet long they are unwieldy for the gutter ways on the river, and the stern wheel instead of being inboard projects some distance over the stern. It is frequently necessary to run these boats stern first in the narrow ditches that prevail in the river during the low season, and the stern wheel from its exposed position is liable to come to grief. The engines are triple expansion. It is stated the suction pipes are all at the bottom of the vessel instead of at the side, and this is a mistake for an Indian river. The steamers are capable of carrying 75 tons of cargo.

Experts are now making suggestions for certain alterations to adapt them to the requirements for which they were originally built.

BOMBAY.

(From our own Correspondent.)

THE Health Officer's report, to which I alluded in my last letter, has been recorded by the local Corporation and copies have been forwarded to Government, with special reference to the paragraph relating to the accommodation of sick Railway passengers.

A recent issue of INDIAN ENGINEERING mentioned that Mr. Rienzi Walton, the Executive Engineer, Bombay Municipality, had obtained privilege leave for 3 months; but he is likely to be away from duty for a much longer period, probably 18 months.

Mr. James W. Smith, the Deputy Executive Engineer, has been appointed to act for Mr. Walton during the latter's absence. In connection with this appointment it may be mentioned that the Acting Municipal Commissioner, Mr. Charles, recommended an outsider to act for Mr. Walton on the ground that Mr. Smith was too valuable in his subordinate post, to be promoted to the higher one. It was a curious piece of logic on his part to make merit a bar to promotion, and Mr. Charles would hardly like such logic to be enforced in his own case. To Colonel Merewether, who also argued against Mr. Smith's promotion on similarly absurd grounds, the same remarks apply.

The blasting operations at the Prince's Dock have been much protracted owing to the difficulty experienced by the divers in getting at the bore-holes beneath the water, this having been rendered almost inaccessible by the enormous quantity of *débris* of the blasted portions of the wall between the Prince's Dock and the New Dock. In my next letter I hope to be able to send you a full account of these operations.

The intelligence that Colonel J. G. Lindsay, Chief Engineer and Agent of the Southern Mahratta Railway, had become very seriously ill caused a wide spread feeling of regret in Bombay, where he is so well known, and all who are acquainted with this able and zealous officer trust he may speedily recover.

The prospectus of a projected steamship Company has been lately appearing in the local papers, the *raison d'être* of which Company is to construct a line of steamers of extraordinary speed, 50 miles an hour being the modest figure mentioned. With the mail contract given to such a line what a revolution would be effected! Allowing for ordinary detention in the Canal we should have our mails delivered here in a week from Brindisi.

On the 2nd instant the Bank of Bombay raised its rate of discount to 6 per cent making its minimum rate the same as the Bank of Bengal. Money has been in great request throughout the past week, and will probably become dearer still during the coming one.

I subjoin the names and tonnage of vessels docked at the Hydraulic Lift

Last month:—

<i>King Arthur</i>	...	...	1,416 tons.
<i>Kirby Hall</i>	...	...	2,692 "
<i>Aston Hall</i>	...	...	3,568 "
<i>Ship Sierra Lucina</i>	...	...	1,746 "
<i>Bay of Panama</i>	...	...	2,281 "

The exports from Great Britain of Railway Iron into India during the 11 months ending 30th November 1887,

indicate a marked increase, as compared with the two preceding years, during a corresponding period amounting to 300,910 tons, as against 271,018 tons in 1885, and 258,796 tons in 1886. India in fact monopolizes about a third of the total exports of Railway Iron from Great Britain.

A letter, which appeared in the *Times of India* a few days ago, over the nom *de plums* "Produce," complained of the defective accommodation provided by Railways at the local termini for goods unloaded there. The writer drew attention to the fact that at Calcutta goods are allowed to remain on the Railway premises for 72 hours without charge, owing to the better accommodation at the Calcutta stations, whereas in Bombay goods must be removed in 24 hours, after which time one anna per day is charged thereon. There is no doubt that the export trade of this city is saddled with a heavy expenditure, which, if better provision were made for the accommodation of goods, could be materially reduced.

The writer of the letter suggested that accommodation should be provided along the docks, thus relieving the export trade of the charges for loading in carts, carting to godowns, unloading the carts at godowns, carting to docks, and again unloading there. Although the Editor of the *Times of India* in a note at foot of the letter expressed doubt as to the practicability of this suggestion, there are many in Bombay who see nothing at all impracticable in it.

XENOPHON.

BOMBAY; February 4, 1888.

NOTES FROM HOME.

(From our own Correspondent.)

A PAPER descriptive of the large roof over the Great Hall of Olympia (The National Agricultural Hall) Kensington, was read before the Civil and Mechanical Engineers' Society at the Town Hall, Westminster, by Mr. A. T. Walmsley M. I. C. E., one of the Engineers of the undertaking. After a description of other arched roofs shewing how the thrust in each case was taken, the author proceeded to point out that the olympic structure was complete in itself, that no thrust was thrown on the side walls, that no anchor bolts were introduced, and that by pivoting the columns under the springing of the central arch, the bending moment upon the column was obviated, and it was therefore unnecessary to thicken the cast iron to resist tension. The Great Hall was shewn to cover a space 440 feet by 250 feet, the latter dimension containing the central semi-circular arch of 170 feet span, and two side gallery frames forming abutments to the arch of 40 feet in width. The arched roof is formed in 11 bays of 34 feet each, enclosed by screens of a vertical ridge-and-furrow type, and acting as continuous girders when the wind blows obliquely upon the screen. At one end the gallery is carried round 40 feet in width, but at the other end is reduced to 26 feet. The main purlins act as continuous girders 18 feet 6 inches apart between the end screens, and the gallery floor girders which run in the same direction as the purlins are also continuous girders. The secondary purlins dividing the space enclosed by the main purlins into three divisions of 6' 2" each are placed radially with the principal, so as to take the weight of the covering in a normal direction, and over each main purlin these secondary purlins are placed tangentially to the curve of the roof, so as to take the weight of the covering and prevent it slipping down the roof. The roof was remarkable for an entire absence of long solid plates, the several parts being greatly developed and so much economy effected by the simple use of lattice construction in the wrought iron, and the prevention of tension in the cast iron, that only 1,200 tons of iron are employed in the whole of the Great Hall. The roof was built by Messrs. Handyside of Derby, the glass and zinc coverings being upon Mr. Hellwell's patent systems.

Two more theatres have recently been destroyed by fire, the Grand at Islington and the Bolton Theatre Royal. Fortunately in neither case was there any loss of life to record. The latter case is said to be the work of incendiarism. The former case has some interest inasmuch as a large portion of the building was of material described as fire-proof. The staircases which were of monolithic concrete are reported to remain intact and uninjured, and the Editor of the *Builder* having visited the ruins confirms this report of the patentees of the evidence of the fire resistance of the concrete work:—He says "The proscenium wall and arch with the concealed girder stand up perfectly uninjured, and even the architectural ornament impressed on the archivolt

of the arch remains uninjured—a remarkable testimony to the fire resisting power of concrete."

A discovery has just been made known of a new application of electricity which bids fair to have a very important bearing on the future of sanitary science. The Metropolitan Board of Works are now carrying out works at the outfalls at Barking and Crossness to cost close on a million sterling. The process to be adopted is of a chemical nature, and the precipitated sludge is to be carried out to sea in specially constructed ships. At this juncture a Mr. Webster has devised the application of electricity, and it certainly has the appearance not only of solving the sewage problem, but of dealing with the further question of water supply. A current of electricity produced either from cells or from a dynamo is sent into the sewage, the transmission being effected through metallic electrodes. Instead of putting chemicals into the sewage this system creates chemicals in the sewage itself by the action of the electrodes on the sewage. Viewed in a glass vessel a black liquid (obtained from the Deptford pumping station of the Board) has all its particles set in a circulatory motion by the electric current, a kind of procession taking place from the top downward and from the bottom upwards. In the result the suspended particles are set at the top of the liquid, thus reversing the usual chemical process which sends everything down in the form of precipitate. So prompt is the effect of the electricity that in the space of 20 minutes a volume of opaque sewage becomes perfectly transparent except at the top where the organic matter collects in a semi solid form. As to the success of the invention everything depends on the financial question, and it is stated from certain data that the cost of thus treating the whole of the London sewage would be about £25,000 per annum, as against the present proposed chemical process which figures with a total cost of £30,000 per annum. With regard to the sludge resulting from the electric process, it is said to have the advantage of possessing some of the ammonia previously held in solution and so being much more valuable. The inventor has also applied his plan with great success to the purification of water, and it will indeed be a singular transformation if the present costly process of the Metropolitan Water Companies which costs nearly £16,000 per annum be superseded by this new development in electric discovery.

With the exception of the serious accident at Doncaster in September, the railway traffic of the country was in 1887 carried on with wonderful freedom from injury and loss of life to the passengers. A striking example of the cordial relations which exist between Railway officials and their employes was afforded by the Manchester Sheffield and Lincolnshire Company offering a week's wages towards the loss which the company will have to bear in connection with the Doncaster accident.

The *Great Eastern Steamship* now lying in the Clyde has, says the *Railway News*, been purchased from the first mortgagee by a firm of metal brokers, having establishments in London, Liverpool and Swansea. It is understood that the huge bulk is to be broken up, the cost of which operation is estimated to be from £10,000 to £15,000. The purchase money was £16,500.

CHINA.

(From our own Correspondent.)

THAT mighty and unruly stream, the Huang-Ho, or Yellow River, having, as already mentioned in my last letter, again broken through its ordinary bounds, and committed fearful havoc in the fertile and densely populated plains of Ho-Nan, An-Hui, and Kiang Su Provinces, I have considered it would not be out of place for me to give your readers the benefit of what little knowledge and practical experience I have acquired on the subject during many years of travelling in the Chinese Empire.

The Huang-Ho, or Yellow River, as is well known to modern Geographers, takes its rise in the elevated mountainous regions, which form part of Thibet, and is fed by the melting snows abounding in those regions. Flowing rather rapidly amongst the mountains, through rocky defiles, and over a stony bed, its waters are usually pretty clear until it enters the borders of China about a degree or so north of the Kokonor, or Tsing-Hai Lake, where I have crossed it in summer time, and found it to be, as well as I now remember, about 200 yards wide and from 6 to 8 feet deep, but sometimes much deeper, especially during a very warm summer, when a greater quantity of snow is melted than at ordinary times.

After flowing in an easterly direction through Kan-Su Province, to some distance east of Lan Chou Fu, the provincial capital, its course takes a sudden or abrupt turn to the north, and flows on towards Ning-Hid Fu in the same Province, at which point it leaves China Proper, and flows in the same direction through Inner Mongolia, as far as the foot of the Ala Mountains, or about 42° North Latitude, whence it again turns east and flows in the same direction as far as Sala Chi, or Saratai, a frontier town of Shan Si Province, in Lat. N. 40° and Long. E. 111° 26'. At this point it again turns and flows south, forming the frontier boundary, first, between Shan Si and the territory of the *Ordos* Mongols, and then forming the boundary between the two Chinese Provinces Shen Si and Shan Si, as far south as the famous fortified pass, called Tung-Kuan, Lat. N. 31° 09', Long. E. 105° 11', where the frontiers of Ho-Nan Province meet those of Shen Si and Shan Si. Here the river again turns its course, and flows almost due east through Ho-Nan Province to some distance beyond Kai Feng Fu, the capital of Ho-Nan. [N.B.—Ho-Nan Fu is the name of a single Prefecture in the Province of the same name, Lat. N. 34° 43', Long. E. 112° 28'. The position of Kai Feng Fu is Lat. N. 34° 52', Long. E. 114° 33'.] It is in this latter neighbourhood that the course of the river is deflected to the north-east, and has been flowing some distance in that direction through a point of Chih-Li Province, then through Shan Tung Province in the same direction as far as Pin Chou, Lat. N. 37° 34', Long. E. 118° 05', in which neighbourhood the river empties itself in the Gulf of Pechili, in such a tremendous volume as to dye the waters of the gulf its own yellow color, hence the name of Huang Hai, or Yellow Sea, given by navigators to the waters on the north east coast of China.

From the point where the river enters Ho-Nan Province, until it empties itself into the sea in the Gulf of Pechili, nearly the whole of its course is confined within artificial embankments, and in some places the actual bed of the river is far above the low-lying plains, and its embankments look like ranges of sandy hills, when seen from some distance, and it is the construction and repair to these embankments that causes such a constant drain on the revenues of China.

It is recorded in ancient history that the Emperor of Yao placed an officer named Kun or Kwun, at the head of the Public Works Department, in the year B. C. 2291, and directed him to reclaim the land from the waters of the Ho i.e., the Yellow River, which were then overlying the plains of Northern China. Kun labored assiduously at his task for eight or nine years without success, and was finally superseded by his own son Yü on the recommendation of an official named Shun, a worthy descendant of the Yellow Emperor Huang Ti, in the eighth generation.

Yü accordingly entered on his labors in the year B.C. 2286, and was ably supported by his wise and virtuous patron Shun.

After nine years of constant vigilance and steady perseverance, Yü's labors were crowned with success. The waters were brought under control, and their course directed eastwards in two or more streams, some say nine, which threw themselves into the sea some distance apart from each other, draining the country through which they flowed of its surplus waters, and affording means of irrigation over a large area, whenever necessary.

As a reward for his able services Yü was, in the year B. C. 2277, invested with the Lordship of Hsia, a Fief or Principality forming part of the modern Province of Shan Si, bordering on the Yellow River, whence Yü derived his title of *Hsia Po*, or Earl of Hsia. Yü continued to keep the waters of the Yellow River under control, and his worthy patron Shun, having ascended the throne in B. C. 2258, or B. C. 2255, as the chosen successor of the Emperor Yao, continued to sustain him in his important labors. It is also said that Yü performed his task so creditably, and governed his dominions so wisely, that his steadfast friend, the now Emperor Shun, raised him to the exalted position of Co-Regent in the year B. C. 2224, and finally nominated him as his successor on the Dragon Throne, in preference to his own sons.

On the death of Shun, Yü is said to have mourned the death of his patron for three years, and ascended the throne as sole Regent in B. C. 2205, and finally founded the Hsia Dynasty.

Yü's Engineering abilities were no doubt of a high order, as no material change of the river's course is recorded in Chinese history for about one thousand years. During that time great quantities of silt were deposited into the sea near the river's various mouths, thus forming the extensive low-

lying delta-lands which at present are parts of the modern provinces of Shan Tung and Kiang-Su, and extending the length of the river, and its various branches very considerably beyond their former limits. The increase of population, caused also a demand for land, and people occupied the newly formed land wherever practicable. The land was probably reclaimed by the building of embankments as Yü had done before. The increased length of the river and embankments also increased the danger to which the occupiers of the low-lying lands were exposed, requiring constant vigilance on the part of the officials to prevent a rupture of the embankments and a consequent inundation of the country. During the time of the Chou Dynasty, in the seventh century B. C., the river banks (which had probably not been properly attended to) gave way, and the waters let loose flooded the whole surrounding low-lying parts of the country, and appear to have defied all attempts to control them for years,—no doubt causing much ruin and misery throughout the land, and largely contributing to the disaffection of the Feudal chiefs, who afterwards formed the various States known in history as the Lieh-Kuo, or Contending States, which eventually brought about the downfall of the highly venerated Chou Dynasty, and the founding of the Oh'in Dynasty, on its ruins.

Meanwhile the people, despairing of all human efforts to curb the now very unmanageable river, decided to appeal to the gods for aid. A deity was thereupon created for the occasion, and named the 'Ho-Po, i.e., River Lord, which name it appears to me must have been ascribed by the people of former generations to the spirit of the Great Yü, in grateful remembrance of his former achievements in confining the waters of the river to well defined and regular channels in his days. However that may be, one thing is pretty certain, that is, a series of costly periodical sacrifices was then instituted, which included a human victim annually. It was popularly believed that the River Lord, now deified as the River God, required a young and comely maiden for a wife every year. The victim having been selected, and a day appointed for the performance of the ceremony, the people assembled at a convenient place—the modern Prefecture of Chang Te Fu, in Ho-Nan Province.

The maiden chosen as the bride elect was gorgeously arrayed in bridal costume, carried in procession and made the object of special worship on the part of the people, and was then cast into the river to die, in the embraces of the River-God. These inhuman orgies continued in force until the days of the Emperor Wên Hon, or B. C. 424, when a Governor of the locality, whose name was Hsi Mên-Pao, put a stop to them by causing the priests and priestesses, who directed these ceremonies, to be thrown into the river instead of the chosen victim. The course of the river was again confined to certain channels, and appears to have given little trouble during succeeding reigns. The Great Emperor Oh'in Shih Huang Ti caused a portion of the waters of the river to be drawn off and diverted into various lakes, and into the Yangtze River, by means of what is now the Grand Canal, and no doubt managed to keep the river well in hand, as we find him with restless activity forcing hundreds of thousands of his subjects to assist at the building of the great wall, and otherwise busily engaged in repelling Tartar invaders on the northern and eastern frontiers of the Empire.

Another great change in the direction of the river is, however, recorded as having occurred during the first century B. C. with the same disastrous results, and with the same tendency to overflow the rich low-lying lands of Ho-Nan and Shan-Tung, as well as some portions of An-Hui and Kiang-Su Provinces. The main body of water in the river had probably been confined by former Engineers to one great channel, instead of being divided into several smaller ones as had been done by Yü, whose method appears to have given general satisfaction, in his days at least. At any rate, another outbreak of the river is recorded as having occurred during the reign of the Emperor Kao Tsu, of the Sui Dynasty, A. D. 589 to A. D. 617, and is said to have done a great amount of damage. Sui Yang Ti Kao Tsu's son and successor attempted to repair the damage done, and forced immense numbers of men and women to work at building embankments and cutting canals, to divert the waters into the adjoining lakes and the River Yangtze, as Ch'in Shih Huang Ti had done before him six or seven centuries previously.

(To be continued.)

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Madras, January 31, 1888.

Mr. J. P. Davidson, Executive Engineer, 3rd grade, is granted furlough for eighteen months from or after 25th April 1888, under the Civil Leave Code.

Punjab, February 2, 1888.

Irrigation Branch.

In supersession of Irrigation Branch Memoranda, dated 21st November and 9th December 1887, Mr. F. Grant, Assistant Engineer, 2nd grade, attached to the 2nd Division, Bari Doab Canal, is allowed one year's furlough on medical certificate partly in and partly out of India, with effect from the 27th October 1887.

With reference to Irrigation Branch Notification, dated 19th February 1886, Mr. O. V. Yates, Executive Engineer, 4th grade, landed at Bombay, on return from the 18 months' furlough therein granted, on the 7th November 1887, and joined the Dera Ghazi Khan Division, Indus Canals, to which he was posted on the forenoon of the 22nd November 1887.

Mr. O. V. Yates, Executive Engineer, 4th grade, from the Dera Ghazi Khan Division, Indus Canals, which he left on the forenoon of the 28th November 1887, to the Muzaffargarh Division, which he joined on the forenoon of the 26th idem.

Mr. F. W. Schoneemann, Assistant Engineer, 3rd grade, from the Chenab Canal Division, which he left on the forenoon of the 9th January 1888, to the 2nd Division, Bari Doab Canal, which he joined on the forenoon of the 10th idem.

Bombay, February 2, 1888.

His Excellency the Right Honorable the Governor in Council is pleased to make the following appointments:—

Mr. J. Young to be Executive Engineer, Ghar Canals.
Mr. D. George, Assoc. M. Inst. C. E., to act as Executive Engineer, Begari Canals.

This cancels Government Notification, dated 25th January 1888.

Assam, February 4, 1888.

Mr. G. W. Winckler, Executive Engineer, 3rd grade, and District Engineer, Cachar, who was granted one year's special leave, in Orders, dated the 29th December 1887, made over charge of his duties to Mr. D. J. Clancey, Assistant Engineer, 1st grade, on the afternoon of the 23rd January 1888.

Mr. D. J. Clancey, Assistant Engineer, 1st grade, who was transferred to the Cachar district, in Orders, dated the 29th December 1887, reported his arrival at Silchar on the forenoon of the 22nd January 1888, and assumed charge of the Cachar district from Mr. G. W. Winckler, Executive Engineer, on the afternoon of the 23rd idem.

India, February 4, 1888.

Lala Bhupat Rai, Apprentice Engineer, State Railways, is promoted to Assistant Engineer, 3rd grade, with effect from the 1st January 1888.

The services of Mr. G. M. R. Field, Executive Engineer, 2nd grade, and Mr. C. J. O'Brien, Assistant Engineer, 1st grade, Punjab, are temporarily placed at the disposal of the Foreign Department, for employment in the Patiala State.

The services of Mr. W. Drew, Assistant Engineer, 1st grade, State Railways, are placed at the disposal of the Government of Bombay, for employment on the Bhavnagar-Gondal Railway.

With reference to Public Works Department Notification, dated 27th July 1887, the services of Mr. P. T. S. Large, Executive Engineer, 1st grade, sub. pro tem., were placed at the disposal of the Agent and Chief Engineer, Bengal-Nagpur Railway Company, with effect from the 1st April 1887.

Mr. G. W. Winckler, Executive Engineer, 3rd grade, Assam, is granted special leave for one year, under the terms of Public Works Department letter, dated 3rd October 1887.

In Public Works Department Notification, dated 8th December 1887, transferring Mr. B. H. Young temporarily to the Accounts Branch, for Assistant Engineer, 1st grade, read Executive Engineer, 4th grade, temporary rank and for Deputy Examiner, 2nd grade, read Deputy Examiner, 1st grade.

Mr. A. D. Anthony, Assistant Engineer, 3rd grade, Burma, is promoted to Assistant Engineer, 2nd grade, with effect from the 5th November 1887.

Mr. C. J. S. Baker, Executive Engineer, 4th grade, sub. pro tem., State Railways, is, on return from furlough, posted to the establishment under the Director-General of Railways.

Military Works Department.

Captain W. D. Lindley, R.E., Assistant Engineer, 1st grade, passed the Departmental Standard Examination as laid down in Public Works Department Code.

Director-General of Railways.

With reference to Public Works Department Notification, dated 25th January 1888, Rai Sahib Kali Sunkur Chatterjee, Executive Engineer, 4th grade, temporary rank, is posted to the North-Western Railway.

Bengal, February 8, 1888.

Establishment—Irrigation.

Mr. C. J. K. Watson, Executive Engineer, having reported his return from furlough on the afternoon of the 1st instant, is granted an extension of furlough up to that date.
Rai Raj Kissen Banerjee Sahib, Executive Engineer attached to

the Mahanuddy Division, is appointed to hold temporary charge of the Pooree Division, *vice* Rai Amrito Lall Roy Chowdry Bahadur, whose services have been placed at the disposal of the Government of Madras.

Establishment.

The services of Rai Amrito Lall Roy Chowdry, Bahadur, Executive Engineer, 2nd grade, are temporarily placed at the disposal of the Government of Madras, Public Works Department.

Establishment—General.

The Lieutenant-Governor is pleased to make the following promotion in the Engineer Establishment with effect from the 28th December 1887:—

Mr. J. O. G. Keddie, from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, permanent.

Rai Kali Prosonno Mukerjee Sahib, Executive Engineer, on leave, is appointed as a temporary measure to be Executive Engineer of the Dacca Division.

The following reversion is ordered with effect from the 25th January 1888:—

Rai Sahib Kali Podo Sen, from Executive Engineer, 4th grade, sub. pro tem., to Assistant Engineer, 1st grade.

Rai Sahib Kali Podo Sen, Assistant Engineer, is posted to the Orissa Circle.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

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- 108 of '86.—Samuel L. Avery, of Louisville, in the State of Kentucky, United States of America, as President and Treasurer of, and for, B. F. Avery & Sons, a corporation formed under the laws of Kentucky, and doing business at Louisville and elsewhere.—For an improvement in ploughs.
- 144 of '87.—Henry Hamilton Remfry, Solicitor and Patent Agent, of 5, Fancy Lane, Calcutta.—For improvements in telegraphic alphabets.
- 158 of '87.—Richard Albert Walker Wale, Telegraph Master, residing at St. Thomas' Mount, Madras.—For the open and closed circuit block system.
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Obituary.

COWPER.—On the banks of the Indus, near Dera Ismail Khan on 25th January, Gerard Cowper, Executive Engineer, Bannu Railway Survey, aged 34 years.

ANSWERS TO CORRESPONDENTS.

"C. F. F." (London), "A. M. I. C. E.," "AQUA PURA," "COMMON SENSE."—In our next.

INDIAN ENGINEERING.

SATURDAY, FEBRUARY 18, 1888.

THE KANDAHAR EXTENSION OF THE NORTH-WESTERN STATE RAILWAY.

As there seems to be a good deal of ignorance about the nature of the country into which the extension of the Sind-Pishin line is to be carried during the present year, perhaps a few words of description will not be unwelcome to our readers.

This ignorance is not dispelled by the few statements which have been published from time to time by the newspapers. The *Pioneer* (which should know better) talks for instance of the range of hills through which the tunnel is to be driven as the *Khojak* Amrán instead of the *Kwaja-Amrán*, as it should be called, and its description of the approaches to the tunnel are also inaccurate. The *St. James's Gazette* describes these hills as "razor-backed;" one epithet is perhaps as good as another if you are addressing an ignorant public, but if we had wished to describe exactly what the *Kwaja-Amrán* range was *not* we should have used this expression. The range of hills where the line is to cross is about 2,500 feet above the Pishin Valley on the east, and 3,500 feet above the Reghistan desert on the west. The line as now laid out has a ruling gradient of 1 in 40, and rises to a summit height in the main tunnel of 6,400 feet—Killa Abdulla, the present terminus of the Sind-Pishin Railway, being at an elevation of 5,100 feet above sea-level.

The first five miles of the new line from Killa Abdulla are of an easy character, and only two of the remaining five before the tunnel mouth is reached can be described as at all heavy. The tunnel entrance is nearly a mile below the zig-zag road referred to by the *Pioneer*, and the exit at the western end is also some distance from the foot of the zig-zag on that side.

The tunnel itself will be about two and one-third miles in length, the eastern half being nearly level, and the western on a falling gradient of 1 in 40. While the piercing of the mountain will be facilitated by two shafts being sunk at a distance of about 1½ miles apart, the ruling gradient is nearly continuous from the tunnel mouth to the temporary terminus, a little below Chaman, a distance of 13 miles. On this section also very little heavy work is necessary, two small tunnels, about 200 yards long each, being the only works on it requiring other than coolie labour—the extent of the earthworks being light, except in the first three miles from the tunnel mouth.

Work is at present entirely suspended owing to the heaviest fall of snow ever recorded in those regions. The season has up to date been remarkable for a complete absence of the terrible north-west wind so well-known, and so dreaded. The snow, however, has the advantage of ensuring a good supply of water during the summer months, so that it has some compensating advantages.

To facilitate the transport of materials while the tun-

nel is being driven, a temporary line is to be constructed over the top of the pass. This line will have gradients of 1 in 15 up to the foot of the road zig-zags mentioned by our contemporary, for which special locomotives are being sent out from England. The remainder of the ascent on the east side, and descent on the west, will be overcome by means of stationary engines and inclines worked by wire ropes. These inclines are expected to be in working order during the present year, and we hope to describe them in more detail later on.

STEAM AND FAIR TRADE.

LAST year some 10,000 miles of railway were laid down in the United States of America, and paid for with money borrowed to a considerable extent from British capitalists, the average rate of interest paid for the accommodation being $4\frac{1}{2}$ per cent. India could borrow at a cheaper rate than that for productive works; but unfortunately Secretaries of State for India, and our rulers and governors generally are short-sighted, not business-like after the money making manner of our American cousins. They have been borrowing for railway construction of late for the special benefit of the Western, food growing States, with result that within the last three years the cost of moving grain from them to Liverpool has been cheapened 13 shillings a quarter. One outcome of which reduction in transit rates and consequent ability to undersell the British farmer is that that free trade crushed unfortunate is ruined. Steam has knocked the free trade gospel silly; made of it a mischief working cant for traders of the present day and generation. When it was first promulgated cost of transit from foreign parts neutralized the advantage of cheaper foreign production, and kept the price of food grains steady. And England had a lion's share of the world's trade, a practical monopoly almost of a good many staple manufactures. Mills, machines, mines—all were in fullest remunerative operation. Labor as well as capital abounded. England was the commercial hub of the world, and could afford to defy the world's competition. For years there *was* no competition. All the trading world was content to let England be its chief market; and so the fool's paradise of free trade flourished. It was a paradise too rainbow-like and unsubstantial to last. Developments of steam gave foreign nations the opportunity they had lacked before; they in turn developed their trade and manufacturing resources; cheap labour gave them a great advantage over their English rivals; they were not committed to Free Trade reciprocities. Being thus favourably handicapped they have supplanted English manufacturers and traders and agriculturists in the world's struggle for wealth; and apparently the only story to be told now-a-days of the old country's prospects, is a story of depression of trade, agricultural collapse and misery driving the unemployed classes to sedition.

And the remedy for this parlous condition of affairs? In a late issue a correspondent gave reasons for the faith in him that sentimental dogmas about free trade should give place to the more business-like teach-

ings of fair trading. He pointed out that although Free Trade would be a very good business rule if adopted by all the world's markets, it is, and it needs must be, ruinous for the one nation keeping an open market for unrestricted sale of any foreign wares sent to it, while its own wares are in foreign markets taxed. He suggested that it is the reverse of business-like to allow the reciprocity to be all on one's own side. He advocated Fair Trade. The arguments used need not now be recapitulated. Our concern to-day is with India's trade, and facilities for its transit; and as to those matters, and over and above chances of repudiation of debt by the Government of the United States, we think it would tend to the ultimate advantage of British traders if they invested their money in the development of Indian trade instead of American. Instead of financing United States railway construction, and helping thereby to cut their own throats commercially, let them invest their coin in laying down in India the lines of rail that are the one thing needful for its commercial development. This vast, old and yet inchoate continent has at any rate one great pull over its Western world rival—cheap labor, to wit, and its soil, although it may not be to-day and to-morrow as prolific as the virgin soil of the Western States of America, is easy to work, good to yield crops without expensive artificial manuring, and practically inexhaustible. Let England adopt a system of real, not lopsided, unequal, unreciprocal free trading or fair trading; let her adequately supply this country with railways, so that field produce and manufactures may find ready access to the seaboard,—and Indian food grains will soon drive American food grains out of English markets, and by the cheapening of price, England will be advantaged equally with her great dependency. Trade in many commodities besides corn would be advantaged, import trade as well as export trade; new industries would spring into being, old ones would be given a fillip to; the depreciated rupee would have a chance of recovering its normal value. Let Chambers of Commerce and Trades Associations look to the matter; and for their part in the good work of rehabilitation let Engineers do actively what in them lies to promote railway construction in India. In that direction lie commercial safety and national prosperity for England and India alike, over and above the fact that the steam engine is the most wholesale and efficient educational agent that can be brought to bear on the masses.

It may be objected to our argument that farmers in England will not be advantaged by export of grain from India, but contrariwise. As a matter of fact, however, they will not at any rate be any worse off than they are now, under stress of American competition. Probably, the sooner they turn their arable lands to pasture, and turn their attention to flocks and herds instead of to corn, the better it will be for them. Landlords rather than farmers are the heaviest sufferers at present. Their ruin cannot be either helped or hindered by Indian exports. For if India does not take advantage of the opportunity vouchsafed, American competition will continue to levy indirect toll on British landlords.

They must needs help largely towards paying the piper in any event. Instead of bemoaning a hard fate, let them seek to devise some new event, some better adjustment of trade balances than that which now obtains, some happy financial coup by means of which they may retrieve their fortunes. Meanwhile, the world must go on, and trade with it; will they, *nil* they.

THE TRADE STATISTICS OF CHOTA-NAGPUR AND THE PROPOSED RAILWAY THROUGH IT.

NOT long ago we had somewhat to say about the projected railway from Mogul Serai to Puri, and, in connection therewith Mr. Risley's Note of the 15th July 1882 on the trade and resources of Chota-Nagpur, published with a P. W. D. Resolution on the subject of the said railway, and dated 12th August 1887. The *Gazette of India* of the 4th February informs us that the Note was published "through inadvertence," and in its stead we are favoured with a later one by the same author embodying the results of a more complete investigation. Inadvertence is a fairly long word, and demi-officially must, we suppose, be held to atone for a good deal of carelessness in high places. Let that pass however: proceed we to consideration of Note No. 2, which by the way is not much less antiquated than its predecessor, being dated 7th May 1883. The first thing that strikes one about it is that it is perhaps not quite so rosy hued as No. 1.

Still it is rosy enough to afford ample encouragement to the projected railway's well-wishers, although the coalfields likely to have direct bearing on its prospects are reduced to two; and although we are reminded with reference to copper in Singhbhum that two European companies have already come to grief and liquidation in their endeavours to extract the ore at a paying rate—one of them in 1859, the other in 1862; both of them after but two years' working. In his second Note, too, Mr. Risley seems even more disposed to depreciate the value of his statistics than he was in the first one. That however is a fault on the right side.

The two coalfields likely to affect railway prospects are Jheria and Hingir. The first covers an area of about 18 miles of country, and is said to present special facilities for cheap working, inasmuch as the coal lies very near the surface, and the strata dip at unusually small angle to the horizon. For information about the Hingir field we are referred to Mr. V. Ball's professional opinion, quoted as follows:—

"The seams which are exposed in the portion of the field at present under description are neither very numerous nor individually of promising quality; but it must be remembered that the coal-measure rocks are not only as a whole very slightly disturbed from their original horizontal position, but are much covered by superficial deposits, and that there is a complete want of sections which might show the succession of beds constituting the group. The true or even approximate value of the field therefore can only be ascertained by borings. In the meantime it may safely be asserted that there is a fair prospect of this field proving to be of considerable value."

There is iron beyond doubt in many places; and Ritter von Schwartz, Superintendent of the Government's experimental iron-works at Burrakur, discovered numerous deposits of pure limestone to work it with. A railway seems to be the only thing lacking to make both iron and limestone profitable products. Meanwhile, the expense of cartage over a country with hardly any roads worthy of the name, to the nearest railway station on the East Indian line renders this mineral wealth of no avail commercially. At present, the railway station at Giridi is cut off from the main stream of trade along the grand Trunk Road by the unbridged Burrakur river, which is impassable for days at a time during the rains, and very destructive to carts even during the dry season, on account of the steepness of its rocky banks, and the depth of sand in its bed. That trade, both export and import, seems only to stand in need of communications for its profitable development; and of course construction of a railway would involve construction of feeder roads leading to it. For both cheap labour is available plentifully. This does not mean that there is excess of population as in Behar. *Apropos*, Mr. Risley suggests that when the country is opened out emigrants from overcrowded Behar will emigrate there, and break up fresh land, and introduce improved methods of agriculture. Recent enquiries into the cultivation of sugar-cane in Manbhoom have shewn that the local cultivators are far behind the ryots of Behar. Mr. Risley says both in their system of tillage, and in their treatment of the canes, when cut.

About the capabilities of Chota-Nagpur in the way of trade we wrote at length in our previous article, and a repetition here would be work of supererogation. We would only suggest how greatly it might be developed by the proposed railway, the grain trade more especially in the way of exports, Manchester and Birmingham goods in the way of imports. Moreover, there is the pilgrim traffic to Jugganath Jee's shrine at Puri to be reckoned on. No data are available for estimating its volume; but everyone knows that it must be enormous.

There are Engineering difficulties in the way of the proposed railway. That goes without saying when the country to be traversed is hilly. But the surveys made have shewn that the difficulties to be anticipated are not especially formidable; not nearly so formidable as others that have been successfully surmounted in this country by Engineers. We are quite sure that, if allowed to, they will in a very short space of time add completion of a Mogul Serai-Puri line to the long list of professional triumphs won in India.

No regular estimate is possible as to amount of coal the Chota-Nagpur fields might throw on the market; but the amount would in all probability be very large. The Commissioner of Chota-Nagpur urges the importance of encouraging the use of coal for cooking purposes amongst the people. Wood fuel gets dearer year by year; jungle clearances progress year by year; and the operations of the Forest Department with the view to prevention and remedy of waste, cannot be expected

to bear much fruit for years yet. If then the people themselves could be put in the way of cheap coal for their cooking purposes, necessity for incessant jungle clearances and their prejudicial effect on the rainfall and the soil's moisture might be done away with. And there might be some chance of the cow-dung manure which is now used for fuel being put to its legitimate use on the land. Mr. Risley writes in this connection :—

"While in Raneegunge, in January last, I ascertained that coke is very largely used there for domestic purposes. Every man who works in the coal-mines gets a basket or two of small coal given him free of charge, and most of the miners are reported to help themselves liberally into the bargain. This coal is made into coke and used for cooking. Again, in the east of Govindpore sub-division there are a number of small coal-pits under native management, which export coke to Hooghly and Howrah, where it is sold by retail for cooking. These no doubt are only small beginnings among people who are accustomed to see coal in continual use, who feel the pressure of the high price of wood, and who, as a rule, are not in a position to supply themselves with cow-dung fuel. But the fact that a beginning has been made in a matter where native prejudices are peculiarly strong seems to point to an almost indefinite expansion of coal traffic, directly railways have opened up fresh supplies of coal and made it worth the while of producers to work for the native retail demand. Even now I believe much might be done in the way of popularising the use of coal if the matter could be brought to the notice of natives in some practical way."

In olden times men used to say—

"'Tis love, 'tis love, 'tis love
That makes the world go round."

'Tis railways now. And prejudices, stupidities, bad economies—all sorts and conditions of foolishness—have a bad time of it until they consent to go the way the iron horse points out.

PATENTS IN 1887.—The number of applications for patents in 1887 reached the enormous total of 18,029, a number higher than has been attained in any previous year. The increase over last year is 853, and 1,928 over the year 1885. Previous to the operation of the New Patent Act, which came into force in 1884, the number of applications was about 6,000, so that the immediate effect of the new law was to treble the number of patents. The great reduction of fees payable on a patent was, of course, the cause of this great increase, but how long it will continue is problematical. Next year will be a crucial time with patentees, for, as it is well-known, the first renewal fee does not become due until the end of the fourth year, but then it is a pretty heavy one. The first patents granted under the new Act have just completed their fourth year, and the renewal fees will be due, and it is very likely that an enormous proportion of them will lapse. Under the previous law with the same renewal fee only 30 per cent. of completed patents were continued into the second stage, and we should not be far wrong in surmising that not one-fifth of the 1884 patents will be in force next year at this time. The lowness of the preliminary fee has naturally induced many a one to patent an invention scarcely worth the name, and for which a year's protection may suffice, and in fact nearly one half of the inventions that have been provisionally protected are not thought, by the inventors, at the end of a year, to be worth £3. This is a curious fact, and ought to be a warning to those who feel ready to rush to the Patent Office whenever a new idea strikes them.

Notes and Comments.

A SIGNIFICANT CHANGE.—It is rumored that Major T. Gracey, R.E., Superintending Engineer, Upper Burma contemplates taking furlough in April next.

MADURA AND PAUMBAN RAILWAY.—It is contemplated to carry out this line in connection with the Ramisseram Canal project, which, we learn, is nearly ready for launching.

THE PATTIALA RAILWAY.—The construction of the Pattiala branch line from the Ferozepore-Rewari junction is now under the consideration of the Council of Regency, and it is probable that the work will shortly be sanctioned.

VICTORIA TERMINUS, G. I. P. R., BOMBAY.—We learn that these buildings will be entirely completed in April next, but, strange to say, the Company do not contemplate having any ceremony, although, we believe, this work is one of the most extensive of its kind in the world, and certainly the largest modern architectural work in India.

THE TRANS-CASPIAN RAILWAY.—According to the official Gazette of Turkestan, the Transcaspian Railway will be completed as far as Samarcand by the 27th of May. The earthworks are almost entirely finished. Only two bridges of moderate span over the irrigation canal of Naroupai are not yet completed, but it is stated that they will be finished by the spring.

MAJOR HECTOR TULLOCH, R.E.—Many of our readers may not be aware that this officer, whose appointment to the Chief Engineering Inspectorship of the Local Government Board, London, we recently chronicled, drew up a drainage scheme for Madras, and a water-supply scheme for Bombay. He is an Addiscombe man—that is, was a H. E. I. C. Engineer, belonging to the Madras Corps.

THE BOMBAY TECHNICAL INSTITUTE.—A Bombay paper is sorry to hear that the services of Dr. Walmsley, who came out from England a year since with a very high reputation gained at the Finsbury Technical College and elsewhere, will not be available for starting the work of technical education in Bombay. Dr. Walmsley declines to accept the responsibility of beginning the scheme with what he considers inadequate means. He leaves India almost immediately.

PORT ARTHUR.—Building operations at the dock have, in consequence of the severity of the weather, been stopped, and the labor utilized in digging out the foundations for the west and east walls, so that when the weather admits the construction of them can be proceeded with. A contingent of French masons is expected in the spring to carry on the more important work. Captain Calder has arrived from England to take over the duties of Harbour Master.

THE RESTORATION OF TANKS IN SOUTHERN INDIA.—We are glad to learn from the Proceedings of Government, that in future an annual assignment of Rs. 5,00,000 will be made for tank restoration charges. The entire irrigable area of the Presidency is 5,055,111 acres, and of this area 51 per cent., or 2,566,960 acres, depends on tank irrigation, yielding an annual revenue of 100 lakhs of rupees. The number of tanks in the Presidency exceeds 30,000, of which not more than 10 per cent. irrigate more than 200 acres each.

THE EASTERN BENGAL RAILWAY.—This Railway has fallen into much disrepute ever since the State took over

its management, and complaints regarding unpunctuality in the arrival and departure of trains are becoming very frequent. This state of things, remarks the *Englishman*, to say nothing of the numerous accidents of various kinds, seems to shew that there is something radically wrong in the present management and working of the line. It is surprising that the public have so long tolerated such a condition of affairs.

VICEREGAL COUNCIL.—The Petroleum Bill was passed last week at a meeting of the Legislative Council. Instead of an *ad valorem* duty of 5 per cent., a duty of 6 pies per imperial gallon will be imposed. This higher rate will represent, approximately, 8 per cent. on present value. The Honourable Mr. Westland explained that all petroleum which was proved, to the satisfaction of the Customs Collector to be intended exclusively for the hatching of jute or other fibre, or for lubricating purposes, would be exempted from the duty.

THE AMEER'S ARSENAL.—We may remind our readers that Mr. Pyne, M.I.M.E., the gentleman lately in charge of the Ameer's arsenal, and referred to in our last issue, went to England, to bring out a complete set of machinery for making cartridges, the only important matter in which the arsenal is at present deficient. Another important work to which the Ameer directed his attention was the bringing in of water to the Bala Hissar from a large natural spring, iron pipes for which purpose were sent up in quantities from Peshawur to Cabul.

THE YELLOW RIVER EMBANKMENT.—The Governor of Honan Province has sent an urgent despatch to Pekin, stating that the Imperial Commissioner arrived at Honan on the 4th of December last, and went to examine the breach of the Yellow River on the 9th. 2,000 bamboo rafts were made to convey stones to fill up the gap, but the attempt was unsuccessful, and over 4,000 workmen and three officials, who were in charge of them, were all drowned. The distress in the inundated districts is still very great, despite the relief sent by the Chinese Government to the sufferers.

MORE RAILWAYS IN BURMA.—Colonel W. G. Cumming, R.E., has inspected the country between Martaban and Shwegyeen, where a concession of land has been asked for to lay a metre-gauge railway. The English capitalists who were willing to lay this line some months ago require no guarantee of interest, and there is no doubt if it was laid it would be of great advantage both to the Government and the company forming it. There is but little doubt if the present 320 lines of State Railway in Burma were in the hands of a private company the public would be better served than they are.

EZRA HOSPITAL, CALCUTTA.—We understand that this building will shortly be made over to the authorities at the Medical College Hospital. Since it was opened last year by Lady Dufferin it has been in the hands of the P. W. D. undergoing alterations in regard to sanitary arrangements. Those who have seen the structure assert that it does not need the scrutiny of an expert sanitarian to detect how painfully the commonest laws of hygiene have been set at naught. It is to be hoped the community for whose benefit the structure is intended will not have any reason to regret that Mr. Ezra's generosity was not turned to some other purpose.

RICH GOLD REEFS IN DHARWAR.—It is reported that a reef of extraordinary richness has been discovered near Gadak in the Dharwar District. Assays of hundreds of

ounces are spoken of, and 19 oz. of bar gold is said to have been obtained from a single cwt. of picked samples sent to London. The Bombay Government has been applied to for a mining lease of the land. Mr. Bruce Foote has reported favorably of the locality, and has recommended the exploitation of the Hattee Kuttee reef. We may observe that Dharwar gives its name to a transition series, also found in Mysore, to which the gold bearing reefs of Southern India are confined.

THE MARMAGOA HARBOUR.—The new harbour at Marmagao is spacious, but until the breakwater be completed it will not be safe for steamers in rough weather and during the monsoon. The original plan provided for a breakwater eighteen hundred feet in length at a cost of £160,000. Eleven hundred feet have been constructed, affording some protection to steamers, but the seven hundred feet yet remaining to be done are really the more important part of the whole. For some reason the work is at a standstill, though it could be completed for £30,000, a sum well within the estimate, for only £120,000 has been expended on the portion of the breakwater which has been constructed.

ANOMALIES!—The salaries of Local Board Engineers in Bengal appear to range from Rs. 100 to 1,000 a month, the variation being dependent on no fixed principle. Patna presents the explainable novelty of a first grade Assistant Engineer drawing a higher salary than a first grade Executive Engineer, and the palpable absurdity of a superintending officer receiving less pay than one of the executives under himself! Such things have been known to, and even do, occur in the P. W. D. as the outcome of a combined Civil and Military Establishment, and even then the difference is ascribed to "other"—non-departmental—obligations. Under all the circumstances we might well again say: "Wanted—A Rational System of Public Works."

STATE RAILWAY EXTRAVAGANCE IN BURMA.—In August last the Loco. Superintendent of the Burma State Railway recommended and obtained sanction to the purchase of 500 tons of teak timber in the log from the Bombay-Burma Trading Corporation at a cost of about Rs. 47,000, or Rs. 94 per ton, to make up a couple of hundred goods wagons. The timber when cut up at the Insein workshop cost, it is said, Rs. 137 per ton; while first quality teak scantling cut to dimensions requisite for wagon building could be delivered at the workshop from the Rangoon saw-mills at Rs. 97 per ton and would also save time and labor. In this case there is clearly a loss to Government of Rs. 20,000, which is not creditable to the officer responsible for it.

LICENTIATE IN SANITARY SCIENCE.—The Rules regarding a degree of Licentiate in Sanitary Science of the University of Madras, which are to be considered at the next meeting of the Senate, provide that candidates must have passed the examination of M. B., or the L. M. and S. of that or some other recognised University, or must be Medical Practitioners registered under the law existing in Great Britain. The examination for the degree will be held in Madras once a year commencing on the second Monday in July. Surely Engineering has as much to do with Sanitary Science as either Medicine and Surgery, or both, and we cannot see why a Faculty which has done more for Sanitary progress than any other should be excluded in a scheme of this sort.

WHO IS TO BLAME?—The Lahore paper says:—It seems that they sin most unblushingly in Whitehall. We pointed out some time ago how the indifference of some India Office official to a large order in connection with the new railway to Mandalay had prevented the construction of that line for several months, thus occasioning a great waste of labor and capital. We now read of another case of mismanagement in that quarter, but in a somewhat different direction. A proposal, it appears, had been made in Cawnpore to experiment with English wheat-seed in connection with the agriculture of that district. The seed arrived, but in such a condition as to render germination impossible. Either its quality was bad or its packing was bad; but in either case the India Office was to blame.

CALCUTTA MUNICIPALITY.—It appears from a resolution on the Administration Report of the Calcutta Municipality that the total income from the general fund, water-rate, and lighting-rate, was Rs. 3,00,162, as against an expenditure of Rs. 2,96,189. The improvement of *bustees* costs Rs. 1,36,779. Sanction was accorded the Municipality to raise a loan of Rs. 26,25,000, of which Rs. 8,75,000 was for repaying the loan of 1886. At the close of the last official year the net liability of the Corporation was Rs. 1,69,12,035. The conclusions of the Health Officer in regard to sanitation is that there has been a recent increase of mortality in cholera owing to the want of water, the extension of drainage, unaccompanied with sufficient cleansing and flushing, and insufficient conservancy arrangements.

BOMBAY P. W. D. GUP.—A Correspondent writing to us under date the 9th instant says: As to news, I have noted that the "Dutchman" has done nothing lately, and that is rather a grievance, as there are only 8 First Grade Executive Engineers on a sanctioned list of 12, and of the 8, 4 are acting either as Chief or Superintending Engineer, so that there are practically 8 vacancies; but owing, I believe, to the inaction of the Government of India, 3 of the vacancies are of no use, as they were caused by transfers (temporary) of 3 R. E's. to Military Works under the Supreme Government, and they will not sanction steps being given in place of the men transferred. We all feel much aggrieved, but can do nothing. I am trying to find out whether it is really the case that the Government of India is to blame, but they are so close in the Secretariat that I can learn nothing.

ITEMS FROM KASHMIR.—It is believed that the Sialkot and Jammu Railway line is about to be taken in hand. Mr. Dods, of the P. W. D., Punjab, has been deputed to check the survey of the line, which was formerly done by the N.-W. Railway. It is not definitely known when the work will commence. It is doubtful whether the line would pay. The scheme is *not* the Maharaja's. The State P. W. D. is shewing great activity in the prosecution of works. The Banihal Road is in course of repair, and the Durbar has, on the representation of the Chief Engineer, sanctioned Rs. 60,000 for the purpose. Two Executive Engineers have been deputed to inspect the repairs, and it is hoped that the road will be declared safe before April next. The Victoria Water-Works project of Jammu has, after a good deal of money in survey and other works has been spent, at last been dropped.

INDIAN MILITARY PENSIONS.—The *Rangoon Times* thinks the whole policy of the Indian military pensions should be reformed for those entering the service after a certain date, say 1890. Military men should, like the

civilians, subscribe for their own pensions. The pay of the lower ranks is not large, but as they get on in life, military officers should be able to afford to make provision for old age and retirement easily, as non-officials are obliged to do. And as there are always many more applicants for Military Commissions than there are Commissions to give, there could be no hardship whilst continuing the present system of pensions for all now in the service, in the Government giving notice that after a certain time, military men entering the service would have fixed deductions made from their pay for pensions, like the Covenanted Civilians have.

CIVIL ENGINEERS' PROVIDENT FUND.—A Resolution, published in the *Gazette of India*, announces that His Excellency the Governor-General in Council has decided that pensionable Civil Members of the Superior Revenue Establishments, State Railways, who are excluded from participation in the benefits of the State Railway Provident Institution, are admissible to the Civil Engineers' Provident Fund. Under the rules of August last arrears in one sum may be paid by the officer of the above class joining the fund for the whole or any portion of the period between 1st January 1886, when subscriptions to the State Railway Provident Fund were disallowed, and the date of joining the Civil Engineers' Fund. In the case of officers now in India no arrears will be allowed to be paid later than 30th April, and in the case of officers out of India no arrear payments will be allowed after the expiry of three months from return from leave.

THE UNCOVENANTED CIVIL SERVICE MEETING.—The meeting of the Uncovenanted Association, held on Saturday, the 11th, at the Dalhousie Institute, was attended by more than sixty of the chief Uncovenanted Officers of Government. The following were among those who were present:—*Public Works Department*.—Messrs. R. G. Macdonald, F. P. Quinlan, E. J. Martin, J. B. Braddon, R. B. Buckley, F. Collett, W. Mellor, H. P. Burt, W. B. Gray, P. D. Barclay, W. Ogden, H. W. Bennett, A. B. Prussia, S. G. Wood, E. J. Neuville, G. A. Jones, and G. M. Drury. *Telegraph Department*.—Messrs. R. C. Laughlin, F. Kinsman, O. H. Reynolds, T. Blissett, W. King, W. F. Melhuish, and E. C. Bird. The meeting was representative in the best sense of the word, and comprised men of academic distinction, scientific attainments, and long and distinguished service. We feel sure that it will have an important and beneficial effect on the future of the Uncovenanted Service.

MILITARY WORKS IN THE BOMBAY PRESIDENCY—1886-87.—The expenditure on military works during the year amounted to 22 lakhs of rupees. About 4 lakhs were spent on defence works at Aden, about half a lakh at Kurrachee, and something over a lakh at Bombay. The whole scheme for the Bombay defences has not been finally decided upon. Hence comparatively little work was done during the year. Unfinished work was, however, progressed with at five batteries. At Aden good progress was made with fortification works, and the Telegraph Bay Battery was almost completed. The work for the further protection of the sea face at Manora Point, Kurrachee, was pushed on. Various works intended to afford increased accommodation for troops were undertaken, and among them may be noticed the additions to the Colaba barracks and the improvements (chiefly sanitary) to the Ghorpuri barracks at Poona. The new European Station Hospital at Ahmedabad was nearly completed.

A SUGGESTION.—Probably most of us in Calcutta have

had occasion at some time or other to proceed to the nearest Police Station, and doubtless had difficulty in finding the said local thannah, until after frequent enquiries had been made of strangers, when an ordinary building with a small sign-board was pointed out as the place sought for, and the presence of a red *puggree-wallah* at the gate confirmed the fact. Any one who has entered one of these places would see at a glance that there is a sort of makeshift look about the whole thing, and the probabilities are that a large expense is incurred annually in house-rent, &c. It would be interesting to know what this expense amounts to, and whether well designed and well marked buildings could not be erected without adding a pecuniary burden, and yet providing places which are Police Stations. The remarks made on the subject of thannahs are equally applicable to Branch Post Offices, many of which are scattered about the town and some accommodated in most unsightly hovels. It would not ultimately be more expensive were suitable structures built for these important little places.

SURVEY OF INDIA PHOTO-LITHO OFFICE, CALCUTTA.—On Wednesday, the 2nd instant, a large gathering at the grounds attached to the Survey of India Offices testified to the interest taken by that Department and by others in the progress of this group of buildings: it was on the occasion of the ceremony of turning the first sod at the Photo-Litho Office building to which we have recently referred. Mrs. Thuillier, wife of the present Surveyor-General, had kindly consented to do honor to the occasion by her presence and by gracefully overturning the sod by means of a native spade (*Kodali*). In the absence of Colonel Neill, Mr. Gwyther briefly stated the object of the ceremony, and the interesting fact that the present Surveyor-General's father, Sir Henry Thuillier, himself well known as the head of the same Department, had conceived the idea of grouping the various offices of the Survey Department within one site in suitably designed buildings, and the act just performed by Mrs. Thuillier had, as it were, set the work agoing in connection with the last block, for which work, we understand, a full grant has been provided in next year's budget.

INDIAN RAILWAY CONTRACTS AND TENDERS AT HOME.—The Bengal-Nagpur Railway wants a supply of horse boxes, powder vans, carriage trucks and timber trucks. The Bombay, Baroda, and Central India Railway invites tenders for the supply of best South Wales steam coal. The East India Railway calls for a supply of cast-iron plate-sleepers, steel rails, steel fishing-plates, steel fish bolts and nuts. The Great Indian Peninsula Railway's requirements are miscellaneous—locks, hemp, twine, &c., lamp wicks, paints, drysalteries, &c., Portland cement, railway tickets, lamps, and lamp fittings. The Madras Railway's want is iron-covered goods wagons. The Indian Midland Railway calls for a supply of Sheffield tools, anvils and vices, brushes, weighing machines, spring steel, smith hearths, bellows. The Southern Mahratta Railway's requirements are for locomotive engines and tenders, underframes, &c., for third-class carriages, wheels and axles, laminated springs, axle boxes, engine main shafting, brackets, and drums, portable forges, anvils, &c., miscellaneous stores. The Indian State Railways invite tenders for a supply of carriage ironwork and fittings, locomotives and tenders.

IRRIGATION WORKS in MADRAS, 1886-87.—We glean from a review of the Administration Report that the Major

Works call for but little comment. The ill-fated Kurnool Canal shews a steadily increasing deficit, and the total acreage irrigated shews a falling off, notwithstanding the most liberal concessions on the part of Government to induce cultivators to raise paddy with canal water on their lands. The Bellary-Kistna State Railway is now open to Nandyal, and it is possible that this may stimulate the already increasing goods traffic, and initiate a passenger traffic, of which hitherto there has been none. The year has been notable in the Godavary for the highest flood on record, which caused a good deal of damage to canals and embankments and necessitated considerable remissions of revenue. On the Buckingham Canal Rs. 2,52,336 were expended under "Capital," and Rs. 1,12,901 under "Revenue," and so much good was done that when the glory justly due to the constructors of this great work (to which there are already many claimants) comes to be apportioned, some share will undoubtedly be due to the officers now working, and who have yet to work upon it in order to bring it to completion.

MADRAS COLLEGE OF ENGINEERING.—As regards the selection of gentlemen to fill the two newly-constituted Professorships—Engineering and Mathematics—the Director of Public Instruction suggested that the Secretary of State be invited to place the nomination in the hands of Sir A. Taylor, the Principal of Cooper's Hill College, Sir Philip Magnus, Director and Secretary of the City and Guilds of London Central Institution, and of Mr. Unwin (formerly of Cooper's Hill), Professor of Engineering in the same institution. He considers it most desirable that the gentlemen selected should have practical experience of technical educational work in one of the large Science institutions, such as the Technical College, Finsbury, Owen's College, Manchester, and the Yorkshire College, Leeds. The salary of each Professorship is Rs. 500—750, rising by annual increments of Rs. 50 to begin with, but as the scale of establishment provides for promotion to the salaries of Rs. 750—1,000 and Rs. 1,000—1,250, it was necessary that the relative position of the Professors should be fixed and therefore decided that the Professorship of Engineering be regarded as the Senior Professorship of the two; and consequently that the gentleman holding this Professorship shall have priority of right to promotion on completing his term of service, six years, in the higher class.

THE PRINCE'S DOCK EXTENSION.—This important undertaking is now in such an advanced stage that it is expected that during the course of a week or so the water will be admitted into the basin of the dock. The whole of the earth has been excavated from the interior, the walls have been completed, and the wharves and the sheds, covering something like six acres of land, are also on the eve of completion. The *caisson* across the communication passage is finished, and the wall which separated the two docks is being blasted away, it being anticipated that before the end of the present month its entire removal will be accomplished. We hope to give a detailed account of these operations at an early date. The iron sea gates, each leaf of which weighs no less than a hundred tons, are nearly completed, as is likewise one of the swing bridges, while rapid progress is being made with the other. And another four weeks or so will witness the completion of the hydraulic capstans, the machinery for working the sluices, dredgers and gates, and the hydraulic engine house. The basin occupies nearly twenty-

five acres, and its depth is thirty-eight feet. At the present time two powerful dredgers are especially engaged in removing the main dam at the entrance. The dredgers are capable of lifting from 8,000 to 10,000 tons per day, so it is expected that they will finish the work in a month or so from now. The dock will be ready to receive ships at the beginning of April.

"AMUSINGLY AND AMAZINGLY INCORRECT."—The *Bombay Gazette* writes:—A Home paper, in commenting upon the Honours list, remarks that "the determined energy which General Browne and his subordinate Mr. O'Callaghan displayed in their trying duties on the Bolan Railway certainly merit the Knighthood and Companionship in the Star which they gain." This is a Home comment, but like much that is written in England on Indian affairs it is amusingly and amazingly incorrect. Mr. O'Callaghan, as everybody knows, was never a subordinate of General Browne, and General Browne never had anything to do with the Bolan Railway. As a matter of fact, known outside his department as well as within it, he opposed that particular scheme to the utmost, though it enabled the Hurnai line, which may more properly be called his work, and the whole of the railway on the plateau to be opened a year earlier than would otherwise have been possible. When the position of the two officers relatively to the work is considered the absurdity of the comment will be apparent. Mr. O'Callaghan has a place—perhaps the foremost place—amongst the best half-dozen Civil Engineers in India, and if equal justice be done as between a Civil Engineer and a Royal Engineer he should in time get the same honour that has been bestowed upon General Browne. To make a line like the Bolan in twelve months is no small achievement, and when he has supplemented it by completing the Khwaja-Amran project he will have in truth won his spurs.

RAILWAYS IN WESTERN INDIA.—The year 1886-87 was marked by a large extension of the existing railway system. 708 additional miles were either newly opened for traffic or were transferred to the control of this Government. 250 miles of the Southern Maharatta Railway alone were constructed and utilized for traffic, and 253 miles of the Cawnpore-Achnera Railway transferred from the control of the Government of the North-West Provinces to this Government. 559 miles of railway were under survey during 1886-87. The most important of these lines were those in Kattywar. During the year under review great progress was made with lines under construction on the Southern Maharatta Railway, and the Hubli-Harihar, Poona-Koregaon, Koregaon-Miraj, Dharwar-Deuli, and Londa-Belgaum sections were opened up for traffic. Intimately connected with the Southern Maharatta Railway is the West of India Portuguese Railway which will bring Goa into railway communication with Dharwar and Belgaum. The work at the tunnels on the frontier was pushed on and the traffic conveyed over the *Ghât* by a bullock service. It is anticipated that the lines will be connected in January 1888. The Morvi Railway was completed during the year and satisfactory progress made with the Junagad Railway. Speaking generally, the earnings of the different lines during the year exceeded those of 1885. The increase was due chiefly to increase of goods traffic, but on some railways, such as the Southern Maharatta Railway, there was an increase of third-class coaching traffic proportionate to the growth of railway mileage.

Current News.

THE railway works toward Chaman and Killa Abdulla are arrested owing to the snow.

MR. GUILDFORD MOLESWORTH proceeds shortly to Burma to inspect the progress of the Toungoo-Mandalay Railway.

COLONEL WALLACE has brought out a German Engineer to lay the rails on the "Abt" system on the North-Western Railway.

THE Raja of Chamba has made a free grant to Government of the land required for the extension of the Bakloh Cantonment.

ENGINEERS have been appointed by the Government of India for the frontier defence works, sites for which are being selected in Upper Sind and on the frontier.

SIR CHARLES ELLIOTT after the production of the Budget will make a tour southwards visiting on his journey the works of the Bengal-Nagpur Railway Company.

A DEPUTATION from the Government of Netherlands, India, has arrived at Calcutta, to discuss with the Government the question of permitting the emigration of Indian laborers to Sumatra.

THE Assam authorities have sanctioned the suspension of revenue to the extent of Rs. 1,93,000 in the Surma Valley in consequence of the damage done to the crops by the floods of 1886.

THE lines of the new tramway for Madras have arrived from England, and the work of laying them will probably commence in March next. It is stated that steam is the motive power that will be employed.

THE diversion across the Palar, on the Northern Extension of the South Indian Railway, has just been inspected and passed for traffic by Major Sidney Smith, R.E., the Junior Deputy Consulting Engineer for Railways, Madras.

THE pipes are laid which are to give Amraoti its water-supply. The project involves filtration through two large filter beds. The purer water-supply, it is to be hoped, will tend to check the spread of epidemics and thus reduce the abnormal death-rate in the Berars.

It is announced that it has been proposed to construct a large new station building at Hughli at the junction of the line near the Jubilee Bridge. The new house has been designed, and is awaiting the sanction of the Railway authorities. The estimated cost for this new station is said to amount to about a lakh-and-a-half.

THE new Goa Railway will work in concert with the Southern Mahratta Company on the land side, and with the old and wealthy British India Company as their agents for the sea. The rates have been arranged so as to compete with the G. I. P. Railway with Bombay as its outlet, and with the Madras Railway running southwards.

THE Punjab section of the Dehra Ghazi Khan and Pishin Road, which, as we noticed the other day, has just been inspected by General Perkins and Mr. E. Oliver, seems to be making rapid progress towards completion, and a few months more will probably see the opening of another of our most important lines of frontier communication.

WE are glad to hear that, in deference to the expressed wishes of the Board of Directors, the Agent and Manager of the Madras Railway has supplemented the gratuity of £200 already made to the widow of the late Assistant Engineer, F. C. Bullmore, by the Home authorities, with a further sum of Rs. 1,318 from the sick and allowance fund of the Company.

THE Simla Town Hall is at present in a most deplorable state. The ill-laid and badly constructed tiles have admitted such a large amount of drift snow—which melts whenever the sun shews itself—as to threaten not only the destruction of the ball room floor, the corridors, and the rooms occupied by the United Service Institution, but also the theatre with its costly furniture, and the security of the entire walls beneath.

THE frontier lines have both been blocked. Recently owing to breaks on the Bolan line, the mails were delayed, and had finally to be sent *via* Hurnai, but the traffic on the Hurnai line was also stopped owing to an accident. It seems that one of the wagons of a goods train was derailed at a sharp curve, and ran three 600 yards, when it reached a bridge and toppled over into the river. Three other wagons were derailed also. The damage to the line and bridge has temporarily stopped traffic.

Two new floating wharves will shortly be constructed, and floated at Sparks and Lewis Street, Rangoon, and will be of similar design. The entire length of each wharf will be 250ft. The average

freeboard will be 3ft. 6in., and shore moorings will be provided for vessels coming alongside. At dead low-water there will always be 23ft. of water, enabling deep-laden vessels to avail themselves of the increased accommodation, while sampans and smaller craft will always be able to find landing facilities. The cost will represent about two lakhs of rupees.

WE understand Mr. Dawson's own short line between Thatone and Dooyenzeik is doing fairly well, but we have been told if it could be extended some five miles further the receipts would be doubled for it would then reach rich paddy fields, from which grain now has to be carted for many months of the year. Mr. Dawson has the rails on the spot for this short extension, and we hope the Government will grant him the required authorization for these five miles. The working of the 9 miles already laid is giving every satisfaction to the public, and the extension of such a useful line of private railway is much desired by the people of those parts.

As the construction of the masonry bridge across the Ponnai River to the north of Cuddalore on the road to Pondicherry, and of the girder bridge across the Gadilam, the collective estimates for which amount to Rs. 3,32,000, are works of some magnitude, the District Board consider that the supervision of them, in addition to his ordinary duties, would be more than the Local Fund Engineer could conveniently cope with, and they consequently requested that arrangements might be made to put both works in hand at the same time, and that a special officer of some standing and attainments might be deputed to supervise their construction. Government have coincided with the views of the Board.

THE prospects of a water-supply for the town of Bangalore seem to be as far off as ever. For nearly 40 years the subject has been before the public without being practically solved. A scheme of General Sankey, which was sanctioned in 1870, cost nearly five-and-a-half lakhs to the State, but proved an utter failure. Since 1860 the Madras Government have spent upwards of three lakhs on the Ulsoor Tank water-works to supply the European barracks, and its maintenance costs annually Rs. 27,000. General Mullin's scheme proposed to supply Bangalore for about Rs. 19 per thousand gallons. As the same quantity of water costs in Calcutta less than four annas and in Lahore six annas, the Municipal Board have refused to sanction any proposal which will not give them pure wholesome water at the Calcutta or Lahore rate.

THE Western Jumna Canal was re-opened on the 7th current after a 30 days' closure. The closure was necessitated by the damage which had occurred to the Dadapur regulator during the heavy floods of February last. On that occasion the Sub-Himalayan torrents, which cross this canal above Dadapur, came down in unprecedented volume. The works have had to be strengthened and raised to obviate similar accidents in the future. The Canal Department has recently constructed a private telegraph line from the head-works of the Western Jumna Canal to the Munak regulator, whence the Hansi and Delhi Branches bifurcate. There are to be six signal stations, two of which are connected with public lines. It is proposed to reduce the establishment on this canal, and after the current financial year the Karnal and Delhi divisions will be incorporated in one charge.

AMERICAN railways have now reached the length of 150,710 miles, of which 12,724 miles were laid during 1887. The new mileage cost \$325,000,000.

M. TIRAUD has refused to grant permission to hold a lottery in connection with the Panama Canal Loan. Count de Lesseps is urging the shareholders to petition the Chamber of Deputies against this refusal on the part of the Minister of Finance.

In consequence of the post of Commanding Royal Engineer at Chatham being abolished, the duties will, in future, be performed by the Commandant of the School of Military Engineering, and a new Chatham sub-district will be formed to include the former Gravesend sub-district.

REVISED regulations for the government of the Royal Military Academy at Woolwich have been issued with effect from the 1st of November. Intending candidates may present themselves at any of the forthcoming examinations by the Civil Service Commissioners with a view to their passing the preliminary examination.

In a paper read by Mr. B. Houghton before the Society of Civil and Mechanical Engineers, the following instances of the power of waves were cited: At Wick a mass containing 1,500 yards of cement rubble weighing 2,600 tons was carried away. On another occasion the piece which fell under the blows weighed 1,350 tons, and waves have been known to rise to the height of 150ft. at Wick. At Dunbar dynamometer tests of wave pressure shewed $3\frac{1}{2}$ tons per square foot, and the average winter pressure was 0.23 tons. At Zetland blocks of stone weighing $9\frac{1}{2}$ tons have been quarried out of their beds by wave action, although 80ft. above high water.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

BHAGULPUR WATER WORKS.

SIR,—My attention has been called to a letter in your issue of the 21st ultimo, signed "Observer," in which it is stated that "there are two water-works at Bhagulpur, one for the Central Jail having its pipes, engine and tanks separate from the Municipal Water-works."

This statement is inaccurate. Formerly there were separate water-works for the Jail, with a separate pumping station; but the latter does not exist now. Since the 15th August last the water-supply of the Jail has been taken from the Municipal Water-works, a measured quantity being delivered daily into the Jail tanks. For this Government makes a monthly payment to the Municipality.

W. LEONARD,

Superintendent, Bhagulpur Central Jail.

BHAGULPUR; February 7, 1888.

MARRYATT'S SPECIFICATIONS.

SIR,—I have read your review of the last edition of the above compilation edited by Lieutenant-Colonel A. R. Seton, R.E., with attention and interest.

With your permission I touch upon the subject of "Iron Roofs" given in the book.

The diagrams of roof framing and their dimensions, I believe, are simply copied by the compiler from the "Examples of Iron Roofs" by Thomas Timmins.

These roof trusses are calculated to bear a slate covering with wind pressure of 40lbs. per square foot on covered area. The tension members, which are shewn to be of welded iron, are calculated, with others, to bear a stress of 6 tons per square inch.

The method used by Mr. Timmins for finding stresses in the trusses is the old and inaccurate one. Not only this, but some of the details given are very defective and objectionable, as some of the lines of actions do not meet at a point as they ought.

In short, the compiler selected some old form of trusses and most defective details for the use and guidance of the Public Works Department.

DORABJI B. RABADINA.

BOMBAY; February 6, 1888.

KEEPING UP A ROAD.

SIR,—May I trouble you for your advice on the following, which is of great importance to me, and probably may be so to others in the profession. I refer to the Maintenance system of Roads. To keep the roads in repair, gangs of coolies are employed and paid monthly. The only result I found of this system is that, I never could get a fair amount of work from the men, in return for the money paid them as wages. It is true they work most assiduously when I am anywhere near them, but this is not always possible, for other works require as well my attention and presence; and the moment therefore the men are left to themselves, they play high jinks. Doubtless you would suggest that this "scamping" work could be prevented by tasking the men, but, I think, you will admit that, it is not always possible to do this. The repairs necessary to a road are so various in nature that, to portion out, say a fortnight's work in advance, is scarcely practicable. However, I did try this system, but the only result on the whole was a deplorable failure and consequent loss of temper. I then tried putting a Sub-overseer over the gangs, but as I never could keep the Sub-overseer solely employed on looking after them, this excuse was invariably offered me when I demanded an explanation for short work. I am now inclined to work on the contract system of repairing roads, i.e., getting the work done by contract, but many who have already tried this, advise me not to do so, for say they, "It is a greater evil, and you had better stick to the less." Between these two evils I am at present, and I therefore appeal to you, or any of your readers, for advice as to the best method of maintaining roads, or of getting a fair return from coolies paid monthly. Trusting I have not trespassed on your space.

REVENGE.

P.S.—I may add that the gangs I refer to are not permanent ones, but are taken on and dismissed as they are required or not.

METAL VERSUS WOODEN SLEEPERS.

SIR,—In continuation of my former letter on the subject of Rai Kunhaya Lal's remarkable paper on "Deodar versus Steel Sleepers" a statement of the actual cost of the steel and iron sleepers used on two great Indian Railways, viz., the East Indian and the Oudh and Rohilkund, may be found of interest.

The cost of wooden sleepers on the E. I. R. is at present—

	Rs.	As.
Sal	...	5 0 each.
Deodar	...	3 8 "

To this must be added the value of the chairs and fastenings which comes to Rs. 1-13-9 each.

Thus we have—

	Rs.	As.	P.
Sal	6	13	9 each.
Deodar	5	5	9 "

The D.O., or Denham and Olphert's cast-iron sleepers, used on the E. I. Railway cost complete Rs. 5-14. Now as regards durability, the average life of a wooden sleeper in this country is 10 years. Sal sleepers are far more durable than deodar. The renewals of D.O. sleepers do not exceed one per cent. per annum, while the renewals of timber sleepers is not under ten per cent. So that there must be an enormous saving in time by using the metal sleepers, especially as every part is now made in the Jamalpur Workshops, the scrap iron from broken sleepers being worked up anew.

With regard to the steel sleepers, the cost of these is Rs. 9-4 each, but almost any kind of ballast can be used. With reference to durability, Mr. Walton, of the Benares Bridge, writes: "No sleepers have, as far as I am aware, ever failed in the open line, but on the works we had some rather crushed in on the upper surface by the heavy 10-ton cranes working over them on curves." Railway Companies probably know their own business, and if they prefer to import steel sleepers at Rs. 9-4 each instead of buying deodar at Rs. 5-6, they have no doubt very weighty reasons for preferring the metal sleeper.

I am not a railway man myself and owe my acknowledgments to Mr. Higher, Resident Engineer at Mogal Serai, for the information which is here given.

W. G. BLIGH,
Executive Engineer.

SEEBPORE COLLEGE.

SIR,—Your readers are probably aware that the Government of India having pursued a policy of absolute exclusion of the passed students of the above College for a period of ten years, was naturally stung with a little remorse for the poor men whom its own professions and former practice have led to a bitter disappointment in their hopes of entering the Engineer grades of the P. W. Department. Accordingly in 1884, a resolution known as the Roorkee Resolution was passed wherein on a re-distribution of the guaranteed appointments throughout India an annual guarantee of one and two appointments alternately was vouchsafed to the Seebpore College. Now the Public Works and College authorities who have the gift of these guaranteed appointments in their hands, are doing a most cruel injustice by conferring them upon men passing out of the College in preference to those who had passed out many years before and had many years' professional experience in the P. W. Department wherein they were, and some of them still are, temporarily employed. It would have required little commonsense to have seen that these latter men, at any rate those of them who had worked satisfactorily in temporary capacities, would have been far better bargains to the P. W. Department, and would have been better able to uphold the prestige of the Seebpore College among Engineers from multifarious schools, than raw passed students, who in their turn, after a term of temporary service, would have had the same chance of entering the Engineer grades.

A case in point has just occurred on the E. B. S. Railway, where a junior student who is fortunate enough to hold a guaranteed appointment as Assistant Engineer, is, for want of Railway experience, posted to Survey duty, while two other students by several years his seniors in College, who are among the unfortunate lot of the pre-guarantee times, are holding charge of important works in temporary subordinate capacities. Such being the case, I would earnestly request Mr. Downing, the Principal of the Seebpore College, in all fairness and justice to his older students, to put himself in communication with the Bengal Government in the P. W. Department with a view to giving retrospective effect to the "Roorkee Resolution" so far as his College is concerned, and thus save these from the ignominy and disgrace of entering the P. W. D. as permanent Upper Subordinates, who have determined never to do so unless compelled by actual starvation.

DETERMINATION.

February 8, 1888.

[The principle enunciated by our correspondent is correct in the main, but with the openings in Local Boards all over Bengal, for L. C. E. or B. C. E. members of the Upper Subordinate service, P. W. D., we think they now have less cause to complain. By appropriating to themselves the appointments created by the Roorkee Resolution, the only incentive to a successful College career would be removed from the way of the present students.—Ed., J. E.]

"AN ENGINEERS' LIBRARY."

SIR,—I noticed with satisfaction some remarks which appeared in your issue of the 28th January regarding the formation of a professional library in Calcutta, and the suggestion is, I see, supported by one of your correspondents, Mr. Bligh, who writes encouragingly from beyond our provincial borders.

For some time past I have been endeavouring to shape out a library scheme which would be both useful and practicable, and I took the following to be the objects to be kept in view:—

- (1.) The establishment of a good reference library.
- (2.) The formation of a circulating library to be available to subscribers.

- (3.) The maintenance of a club for professional magazines and papers.

Of these the 'professional papers club,' being dependent upon the number of subscribers, and the amount of subscription, is a comparatively simple part of the scheme; but there are difficulties to contend against in the other two cases.

I believe, however, there already exists in the Bengal Public Works Secretariat a collection of books and reports, which would form a substantial basis for both a reference and circulating library, and the Bengal Government would no doubt encourage and greatly help a scheme which would be of most unquestionable benefit to the profession in India, and directly influence the manner in which designs are prepared and works executed. I suppose no one, from the ablest down to the dullest member of our profession, would for a moment question the immense advantage of being able to consult recognized authorities, and learn how and why others have conquered, or failed, in dealing with Engineering works; then, if a library scheme is to be really successful something more than a passive interest in the movement must be shown by the majority.

To set the matter agoing I now put forward a suggestion and would like to hear opinions on it: it is that an appeal should be made to members of the profession, asking them to lay the foundation for such a scheme—

- (1.) By presenting useful books for the Reference library, all duplicates going to the Circulating library.
- (2.) By lending valuable works to be suitably deposited and looked after in the Reference library, and called Mr. so-and-so's loan collection: such loan being of course always at the disposal of the real owner.
- (3.) By forming a fund from donations and subscriptions for gradually extending and improving the library.

Were the support of the profession assured, and the response to the appeal sufficiently liberal, strong grounds would exist for asking help and encouragement from Government, and an early opportunity would be taken to appoint a representative and energetic local committee with perhaps corresponding members. It would be their duty to work out the details for starting and working the scheme, and making it as useful as possible, both to those who have the advantage of being within reach of it and others who can never get anywhere near.

W. BANKS GWYTHYR.

[In commending this scheme to the favorable consideration of the profession, we shall on our part be glad to further it as far as within us lies; and we have every reason to believe that the large Engineering firms in, round, and about Calcutta would also accord it their support.—Ed., J. E.]

Literary Notices.

A MANUAL OF CIVIL ENGINEERING. By John Macquorn Rankine. Sixteenth Edition. Thoroughly revised by W. J. Millar, C.E. 1887.

SIX and twenty years have now elapsed since the publication of the first edition of this celebrated text book; and, with the exception of some brief notes added to the Appendix, the present sixteenth edition is almost identically the same. Most books of this class get completely out of date in so long an interval, and their musty tomes are relegated to the shelves of second-hand book-sellers' shops in grimy precincts, but Rankine, like the babbling brook, still "goes on forever."

In 1862, the date of the issue of the first edition, Engineering literature was represented by a very few works, most of which are now almost quite out of print. We had Moseley, Latham, Mahan, and that was about the sum total of any value; besides which, at that time, no respectable comprehensive treatise on Civil Engineering was in existence; hence the appearance of Professor Rankine's great work, in sequence of his "Applied Mechanics," published four years earlier, was hailed with enthusiasm by the profession. It certainly was a wonderful creation of the human brain, and contained so many original and abstruse investigations into obscure problems, which had been only superficially handled before, that it soon obtained a world-wide reputation among scientific Engineers, and still holds its ground as a text book.

Rankine, like a professional beauty, has many admirers, but, with the vast majority of readers, this admiration is from a distance, really intimate acquaintance with the book being more the exception than the rule. Every Engineer has a copy of Rankine in his bookshelf; that is 'considered quite *de rigueur*'; but he is not studied much, for the good reason, that to read Rankine is one thing, but to understand him, quite another. Most of us are in the predicament of wanting some explanatory text to open out the hidden mysteries of the fat podgy book with its glar-

ing red cover. If we don't peruse the pages of Rankine very much, we nevertheless entertain a profound respect for them, and when we open at one, covered with long y 's and dx 's and dy 's on the "Transformed Catenary" or the "Parabolic Rib loose at ends," this sentiment is deepened into positive awe. One is so accustomed to hear Rankine quoted, as if it were Holy Writ, that, to express any scepticism as to the immaculate nature of this work, appears to savour strongly of sacrilege, heresy, or some other damnable sin. However, Rankine has been set up as a Fetish to be worshipped from afar for so long that we are strongly of opinion, that the time has really come for some bold iconoclast to topple the idol down.

The Manual, in spite of some grave faults, which we will notice further on, was a great work in its day, but since that day some 30 years have past and gone, and 30 years mean a great deal of progress in Engineering Science. Notwithstanding the specious announcement on the fly-leaf, that the subject matter has been thoroughly revised, the book, as we have already remarked, is practically the same identical volume we knew in the days of our youth. The fact of a professional work surviving so long on its old reputation, alone forms a high tribute to its original worth. But we think our readers will agree with us, that Rankine must now be considered as pretty well played out, and should be elbowed on one side to give place to some other manual, run on more modern lines, and embracing the latest developments of Engineering and Mathematical Science. The original principles of Engineering Science of course remain the same, but the methods employed in the solution of statical problems have now entirely changed; the analytical system is everywhere being superseded by the Geometrical or Graphical; and the use of the complicated formulæ with which Rankine absolutely bristles is now a thing of the past. To our author belongs the immense credit of having first inaugurated the great change that has since gradually taken place. His chapter on "The equilibrium of impressed forces in a polygonal frame" preceded, by some years, Clerk Maxwell's generalization of Taylor's discovery of reciprocal frame and force diagrams, which in fact formed the introduction to Graphic Statics, a science which has now been developed to perfection by Culmann, Cremona and other Continental writers.

There are at present so many valuable modern works treating on various Engineering subjects, that comparatively little difficulty would be found in compiling a substitute for the "Manual," and a good portion of the book itself might be embodied. It would have to be a very much larger work, with the objectionable points in our 'only' Manual, of which there are not a few, carefully avoided. While fully admitting that there is a great deal that is admirable in Rankine, we shall now endeavour to show the weak points on his armour.

First and foremost, it is an undoubted fact that Rankine is most difficult to follow. To obtain any particular information, one is generally compelled to take several excursions into different parts of the volume. You find something about it in one place, but that again refers you to paragraphs in some other part of the book, which, as likely as not, again starts the bewildered enquirer on a third voyage of discovery, and so, battered about from pillar to post, he at last gives it up in despair.

Rankine generalizes too much. He forgets that we are not all Professors of Civil Engineering Colleges, but simply working members of the profession, and we have not his "Applied Mechanics" (with which we are so heavily dosed) at our fingers' ends. He will not stoop to get off his high horse to give practical examples worked out so as to explain the text which is sometimes very obscure. We will give an example of this. In page 416 a theorem is propounded on the stability of an arch, and then the author goes on to say: "It is through this theorem that the principles of the stability of ideal linear arches or ribs, already explained in article 132 and the previous articles referred to in that article, and also in articles 133 and 139 pages 203 to 218, become applicable to real arches of masonry and brickwork." This is just

Rankine's style; he won't take the trouble to give an illustration of this application in a practical form, and we are left to do it ourselves, at which we should probably fail, as it is by no means so easy. This is a serious fault, of which we have given this one instance, but it occurs right through. Without proper drawings and diagrams and actual examples worked out, the applications of his bald theorems and formulæ cannot be properly explained. Now Rankine's Manual is totally devoid of all drawings, and the few diagrams it displays are meagre in the extreme; this is a fatal blot on the work. As we have already remarked, most of his complicated formulæ are of no use now, as the graphical method has superseded the old analytical process. In very many cases the bare formulæ is given without anything to shew how it is arrived at, and we have to take it on faith; while some are quite useless and merely cumber the page with a mass of figures frightful to look at; for instance, in page 473, to find the stress on the strut of a roof frame, we have

$$S_m = \sqrt{\left\{ H^2 m + \frac{W^2}{16n^2} (n-m)^2 \right\}}$$

No human being in his senses would ever use so complicated a formula, when a few figures put together the right way would give the stress without any difficulty—not to speak of the simple graphical system. In some things (we say it with bated breath) Rankine is actually wrong. In his theory of earth pressure he carefully proves that the direction of R , the resultant thrust on the retaining wall, is always parallel to the slope of the surface, and thus with a horizontal terrain R is likewise horizontal in direction.

According to our modern lights, this is quite incorrect. The direction of the thrust is not affected by the slope of the terrain, but is dependent on the angle of repose and on the angle of inclination of the back of the retaining wall, which latter influence is ignored by Rankine altogether. Our authority for this is Culmann, the Zürich Professor, whose book "Die Graphische Statik" has a world-wide renown. There are, doubtless, other points on which the great Rankine may be proved to be in error.

Some people say Rankine is too highly mathematical; this is true as regards his methods, but we do not object to his mathematical investigations, and only wish they were given in more detail; in fact, Statics cannot be explained properly without the use of the Calculus. We don't mind his functions of this and differentials of that, but what we do find fault with is the absence of practical illustrations understandable to ordinary intellects of the application of his mathematical theories to practice. Let the reader compare Stoney's theory of the stresses in girders and similar structures with Rankine on the same subject and he will see how very superior the later treatment of the matter is. Stoney uses the Calculus, but anybody can follow him; he takes up one subject at a time and finishes it off; whereas with Rankine the reader is knocked about like a shuttle-cock all over the thick, unhandy volume till he finally chucks it away in disgust.

TABLES FOR ROLLED IRON BEAMS. By Lala Ganga Ram, C.E., Executive Engineer, P. W. D., Punjab. Reprinted from "Indian Engineering."

THE demand for these Tables has been such as to induce us to reproduce them in pamphlet form of a size to fit into Molesworth's *Pocket Book*. To enable our readers to correct the "Tables" originally given in Vol III., of this Journal, we subjoin a short list of—

ERRATA.

Page 36—In Col. 3 weight in lbs. per ft. first item,		for 29 read 27.	
In Col. 4 area in sq. in. 16th line,	"	9'3	" 9'0
In Col. No. 17	29th	" 1150	" 1180
In " 20	5th	" 307	" 354
In " 21	5th	" 354	" 307
In " 26	35th	" 355	" 335
In " 29	39th	" 355	" 365
Page 76, In Rule (b) 3rd	"	" 12" × 6"	" 11" × 5½"
Do.	"	" 50ft.	" 20ft.
Do. 4th	"	" 12" × 6"	" 11" × 5½"

General Articles.

IRRIGATION IN EGYPT.

III.—(Concluded).

IN 1883 the company had not yet completed the works, by reason of a disaster which occurred to the machinery at Katatbéh. The ten plate iron archimedian screws of 4 metres diameter and 12 metres in length, which were placed side by side and worked by a horizontal shaft 50 metres long, broke down the first time they were set to work.

The Government then arranged a fresh agreement with the company, whereby it was stipulated that each pumping station should lift 2,500,000 cubic metres daily, and the firm of Farcot of Saint Owen, were instructed to furnish new machinery for the purpose, it being prescribed that the existing head-works and the old foundations should be utilized as much as possible. At the present time the pumping machinery at Katatbéh, which has been in constant work since 1886, consists of five horizontal engines shewn in *figs. 2 to 5*,—*vide* plate in last issue,—which drive directly centrifugal pumps on a vertical axis. The cylinders are of 1 metre diameter and 1·80 metres stroke. The vertical shaft carries at its upper end a horizontal crank worked by the connecting rod of the engine. A fly-wheel of 22 tons weight is fixed on this shaft, which lower down is attached to the rotary pump. The fan is 4 metres in diameter and 2 in width. Before starting the machinery the friction induced in the pivot of the vertical shaft, loaded with a weight of about 50 tons, had to be arranged for. In order to remedy this difficulty M. Vigreux, Civil Engineer, Professor at the *Ecole Centrale* of arts and manufactures, invented the arrangement shewn in *fig. 5*. A continuous current of oil was established round the pivot. The cold oil arriving at one side, when heated, is driven into a tube which leads down to the river, then it is cooled in a worm and lifted by a pump up to the roof of the shed, whence it again descends into the pivots by gravity.

This arrangement is employed on only three of the machines. On the two others M. Farcot has adopted a similar arrangement as regards the circulation of the oil, but with this difference that the motion is given to the oil by means of a small rotary pump fixed at the pivot itself. The oil is cooled in a refrigerator, revolving with the pivot, into which cold water is injected by a pump also revolving with the shaft. This system appears a little complicated.

The pumps make 35 revolutions per minute and discharge 7 cubic metres per second.

To these pumps are added, as a reserve, three of the large archimedian screws formerly essayed, which have been carefully strengthened. Each screw is capable of discharging 2 cubic metres per second. The engines have an effective horse-power of 3,500. The steam is supplied by eleven tubular boilers, of which three of 190 square metres of heating surface were furnished by the Creusot Works, and the other eight of the Farcot type have each 175 square metres of heating surface.

At Atgeh, *fig. 1*, the conditions were quite different, the lift was much less, and besides the old machinery had to be utilized as much as possible.

The pumping machinery, which has been at work since 1885, consists of 8 Sagebien water-wheels of 3·60 metres width and 10 metres diameter, raising the water to an average maximum height of 2·60 metres. They each can discharge a volume of 4 to 500,000 cubic metres in 23 hours. Four of these wheels placed in the old pump-house are driven by the old engines which formerly worked centrifugal pumps. These, which are beam engines with one cylinder, constructed by the English firm of Forester, have now been transformed into Woolf engines.

The remaining four Sagebien wheels are fixed in another building and are driven by two compound engines which formerly worked the archimedian screws at Katatbéh.

The steam is supplied by six tubular boilers of 190 square metres of heating surface each.

These engines are of 1,250 horse-power effective.

Supposing the Rayah de Béhéra was absolutely abandoned and that the province was entirely supplied by the water-lifts at Atgeh and Katatbéh. It will probably be found necessary to start them before the dates fixed by contract, and to make certain of over two hundred working days annually at Atgeh and one hundred and fifty at Katatbéh. Under these conditions the irrigation of the province will cost 1,400,000 francs or about 7·10 fr. per hectare, exclusive of the necessary expenses for the maintenance of the canals and embankments.

Taking these into account, the annual expenditure per hectare will come to 11·80 fr. But up to the present time the Rayah has still contributed to the irrigation of the province, and the cost of irrigation has not exceeded 10·20 fr. per hectare.

We shall do well to pass over this portion of M. Bavois' work to the conclusion, where a *resumé* of the projects of the future is given.

The principal objects to be kept in view are the following:—

1st.—In improvement of the irrigable lands by rendering the discharge of the canals during low water as independent as possible of the actual level of water in the river; in diminishing the cost of watering operations by raising the level of the water nearer the surface of the soil; and in regulating the drainage of surplus water.

2ndly.—In substituting irrigation for the system of inundation basins in parts where this primitive method still survives.

3rdly.—In regulating the discharge of the Nile so as to reduce the very high flood level while raising that at low water.

The last international conventions, which were the sequel of the London Conference of 1884, have accorded powers to indebted Egypt to commence the realization of the first portion of this programme. Out of the loan of 9 million pounds which has been sanctioned by the powers interested, there has been reserved one million sterling for improvements of the system of irrigation. The works charged to this loan fund are now actually in process of construction by Colonel Scott Moncrieff assisted by English Engineers who have acquired in India practise in this description of work.

These works commenced in 1886 are not yet enough advanced to enable us to appreciate the results, but the programme is sufficiently settled to enable us to indicate the main lines. The works are exclusively distributed in Lower Egypt, in the Fayoum, and in that part of Upper Egypt watered by the Ibrahimieh Canal.

In Lower Egypt the projected works consist mainly in the consolidation of the grand barrage at the apex of the Delta, and the distribution of water between the two branches of the Nile, and in three large canals which take their supply from the water upheld by the barrage.

In the Fayoum the works consist in the construction of canal heads, capable of assuming a proper distribution of water among the different parts of the province, and in the substitution at some points of irrigation canals for the system of basins which still prevail there.

In Upper Egypt the principal works are destined to supply with water charged with silt certain areas which at present only receive water at second hand from other basins at a higher level, and which are separated from the Nile by the strip of country watered by the Ibrahimieh Canal.

This work will take two years for proper completion.

The financial resources available are too limited to enable the second part of the programme already mentioned to be carried out.

As for the third, its realization will require, according to M. Jacquet, *Inspecteur General des Ponts et Chaussées*, an outlay of 100 millions of francs.

When will Egypt become sufficiently prosperous to enable her to realize her wishes on this matter?

This is the question raised, but not solved, by M. Bavois at the close of his interesting study on the "Irrigation of Egypt."

Fig. 4 Rear Elev

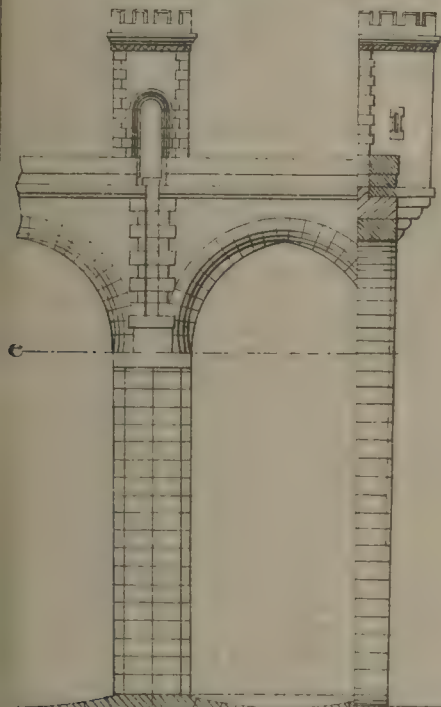


Fig. 10 Section on c. d.

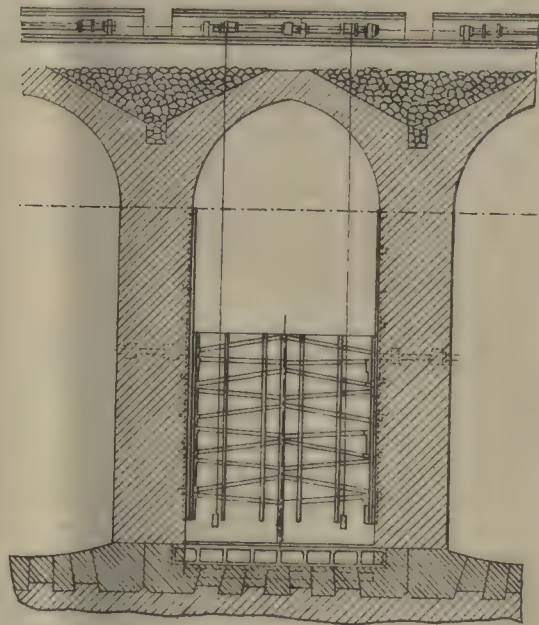
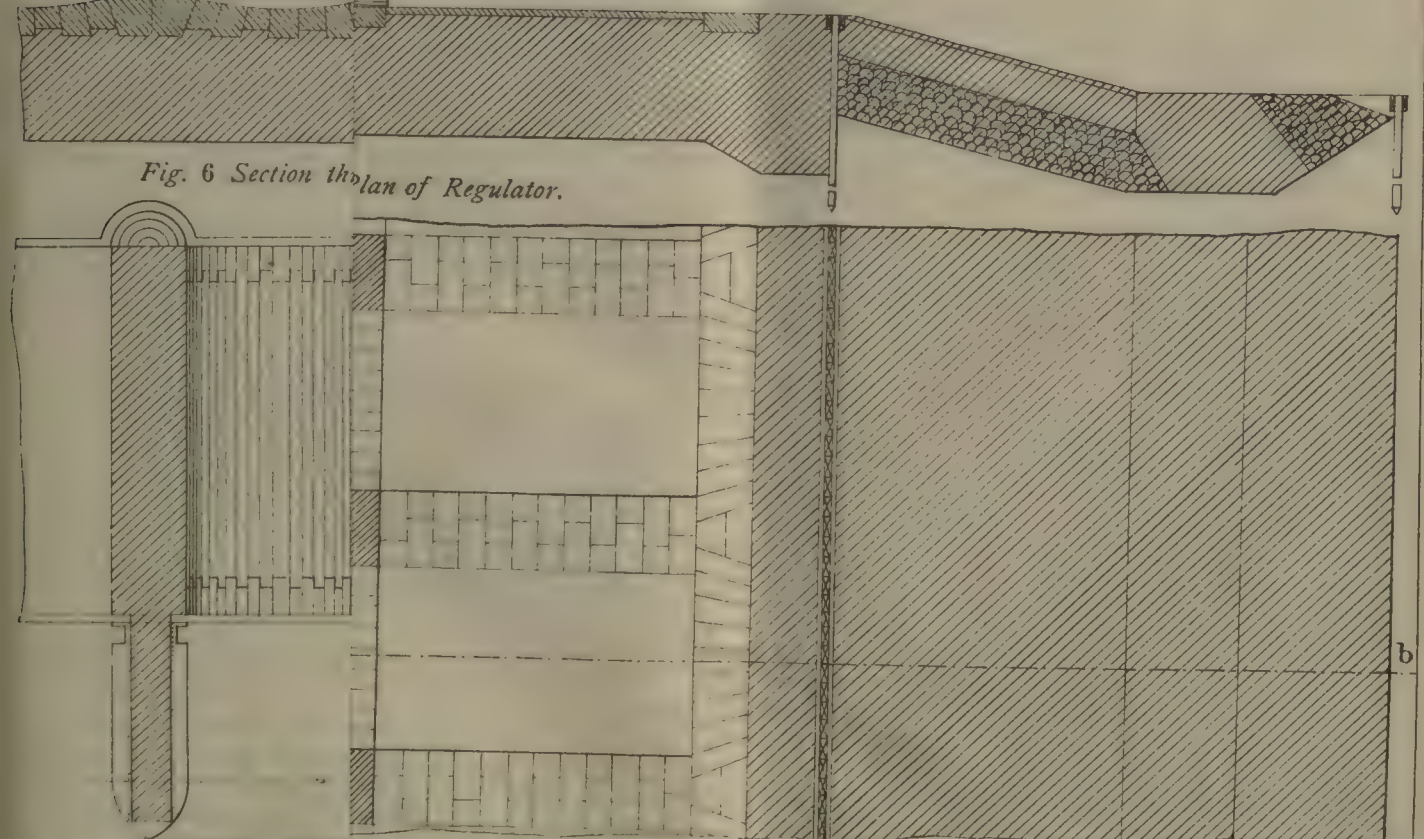


Fig. 6 Section tholan of Regulator.



MAIL STEAMERS AND THEIR SPEEDS.

BY A. EWBANK.

VII.—(Concluded.)

If a steam engine is built on a continent of dry land or is fixed in a floating island called a ship, it may, as already stated, be advantageous to supply it with a condenser. We might imagine an engine worked by air instead of by steam. In such a case the boiler, or substitute for a boiler, may be imagined to heat a certain quantity of air which is delivered cold into the boiler—substitute. The air when heated passes in regular instalments to the cylinder where it acts on a piston and both cools and expands itself in the process. Suppose it were required that the air thus somewhat cooled and expanded should remove itself from the cylinder with sufficient rapidity.

Let us open a communication between the cylinder and a closed vessel. If in this closed vessel there is air or any other gas at a pressure much lower than that of the air in the cylinder—when this air has done its driving work—then the cylinder air will rush into that closed vessel until the pressures in the two vessels are equalized. But the additional vessel could not in this case be called a condenser. There would, in fact, be no condensation of the in-coming air. Condensation means reduction to a liquid. The closed vessel might be made as cold throughout as we may suppose the North Pole to be at midnight and in the month of December. Still the air would remain air—the gaseous mixture which we call air would remain a gaseous mixture.

With steam it is widely different. Let the engine be worked with steam and let the steam be supposed to have cooled down to 50°C . If this steam enters a closed vessel, at which the temperature is 30°C , much of it will be changed to water and the rest will have its pressure reduced to about one-third of what it was at 50°C . That part which has become water now occupies a volume which is not one thousandth part of the volume once occupied by the steam.

If air at a certain temperature and pressure rushes into a closed space where there is air at some less pressure, the in-coming air steadily raises the pressure in the closed space, because none of this air is condensed, i.e., practically annihilated as regards its volume. But when steam enters a closed space—which is much colder than the place which it left—this steam, as it enters, vanishes, so to say. In its place appear a few drops of water which occupy a very small volume. Steam was originally produced by heating liquid water. Cold reproduces the liquid.

If our closed vessel is so arranged as to preserve a pressure less than that which is in the cylinder at the end of a stroke—which we take to be a pressure corresponding to 50°C , and if the difference of pressure is so marked that the steam continually rushes into the condenser in as little a time as the piston takes to make one journey to or fro, then this condenser will enable us to make use in the cylinder of steam cooled down to 50°C . If the cylinder steam requires a longer time to escape into the condenser the arrangement would be fit only for an engine working more slowly. If the cylinder steam escapes in much less time the arrangement would also answer for an engine working faster. The temperature and pressure in the condenser must thus be suited to the required velocity of the engine.

We have now to consider how the condenser is to be kept sufficiently cold to perform continually a rapid cooling and condensing process on the steam that enters it. This steam bringing continually its warm mass into the condenser would in time both heat it and fill it. We, therefore, have a pump called the air pump which removes from the condenser whatever finds its way there. This pump thus removes water, steam and a certain quantity of air which incidentally succeeds in entering. The removal of this mixed mass of water, steam and air

would not of itself be sufficient. We should indeed remove the material bodies, but we should not thereby remove the accumulating immaterial heat. The sides of the condenser and the space within would gradually approach to the temperature of 50°C . Steam of 50°C subsequently entering a space of this temperature would none of it be condensed.

In order to destroy the accumulated heat we apply to the condenser water as cold as we can get. An ocean steamer must for this purpose use the sea water in which it is floating. The colder this sea water the better will it answer its purpose. This water more or less cold might be made to play round the condenser. But it will act more *rapidly*—which is always the important point—if some of the water is injected into the condenser so as to make a fine spray. For thus it intermingles with the entering steam and the cooling and condensing process will be quickened.

The condensation of the entering steam is thus seen to depend for its rapidity on the coldness of the water injected into the condenser. If the injected water were warmer an increase in mass of this water would not be a perfect remedy. If the water equals the steam in temperature no amount of water will effect any condensation whatever. If the water is nearly as warm as the steam, not only must a large quantity of water be used, but the amount condensed will even then be small. This we may call an evil. But the time to effect the condensation becomes considerable. This we may call a greater evil.

Unless we can so arrange that the condenser pressure and temperature are kept decidedly under the pressure and temperature of the steam as it leaves the cylinder—unless we can so arrange that the cylinder steam escapes and is practically annihilated with great rapidity—then our condenser fails of its purpose, and we must for rapid working fall back on our railway locomotive plan of dismissing from the cylinder the steam while yet it is great in pressure. On dry land we can for a stationary engine sometimes obtain water which is much colder than the air. But in mid ocean wherever the air is warm the sea water will not be much colder. Here then is the difficulty for which we have been looking to account for the fact that steamers moving across the North Atlantic find it much easier *rapidly* to condense their steam than do steamers in the Indian Ocean.

If we construct an engine in which the steam to be dismissed has still a high temperature—which means a high pressure—this engine will work well in all latitudes, be they cold or be they warm. If we so construct our engine that the steam is to be reduced in the cylinder to a temperature little above that of the North Atlantic in summer, then this engine will be suitable for *VERY SLOW* travelling across the North Atlantic and will be unsuitable for the Red Sea in, say, the month of August.

A steamer is naturally intended to plough its way through waters of very different temperatures. For instance, the same steamer may have to cross the Indian Ocean in September and the Bay of Biscay in January. As it cannot continually alter the structure of its engines it must be built for the most unfavourable case, *viz.*, for the warmest waters in which it is likely to be plunged. When, therefore, it finds itself in colder waters it is either not so quick a traveller or else it is not so economical a worker, as it might have been made had it been necessary to provide only for moving in these colder waters.

If a steamer built specially for the North Atlantic can make its 19 or 20 knots an hour, we may be satisfied over the Indian Ocean with an average of 15 or 16 knots. If new improvements in machinery enable the Atlantic liners to reach 25 knots, we must not expect to follow up at the same distance and thus to reach 21 knots. So far as these improvements consist of superheated steam, or improved material for the engine, they can be reproduced in Indian steamers. But where the improvements consist in more fully utilising the coldness of the latitudes

in which the steamers travel we are unable to copy the new features. The ordinary railway locomotive is not constructed to take any account of changes in the weather and so it runs with appreciably equal speed in Norway or in Arabia. The more carefully we utilise peculiarities of latitude in our engine construction the greater is the difference which we may expect to find between the best engines specially designed for cold countries and the best engines specially designed for warm countries. This is the point which we set ourselves to explain, and it is hoped that the explanation has been made intelligible to the non-technical public.

THE WATER-SUPPLY ON THE SOLAH KOSWA ROAD.

BY W. G. BLYTH, EXECUTIVE ENGINEER, P. W. D.

THAT portion of the district of Mirzapur which lies to the south of the Son River and the Kaimur Range consists mainly of hilly, wooded and uncultivable land. Thirty odd miles due south the features of the country change; the rolling hills intersected by deep drainage lines are succeeded by a fairly level and fertile plain country.

In this valley is situated the Government Estate of Dudhi, and the shortest line of communication between Dudhi and Chopan on the Son is the so-called Solah Koswa Road. In this intervening wilderness there are no made roads of any kind, the lines of traffic are merely wide tracks through the sparse jungle, and the conveyance of goods has to be effected by pack bullocks. The direction of the trade route is from south to north, and its ultimate destination is the town of Ahraura, which is within 13 miles of the Ahraura Road station on the East Indian Railway. Here reside the *mahajuns* and agents who collect in their extensive godowns stores of stick lac, dyes, seeds, grain, &c., which are eventually packed in bags and sent on by cart to the Railway. The prominence of Ahraura is due to its situation at the foot of the Vindyan Range, which up to within three years ago was quite impassable to laden carts. Hence it naturally formed a goods depôt, as the pack bullocks, as a rule, discharge their loads here and return empty, or laden with salt, sugar, or piecegoods. Of late years the main road from Ahraura to Chopan on the Son has been bridged throughout, and a fine pass constructed over the Vindyan Range. Cart traffic can now extend as far as Robertsganj at the foot of the Kaimur Range, and when two or three nalas are bridged north of Chopan the whole length of road, up to the banks of the Son River, distant 38 miles from Ahraura, will be thrown open. Traffic south of the Son converges at Chopan, as the Markundi Pass over the Kaimur Range, which is a most formidable obstacle, is the only practicable one in this neighbourhood. The main south road runs from Chopan Ferry to Sirguja, a native State in Chota Nagpore, and on the way throws off branches right and left, one to Singrante and Kota on the river frontier, and the other to Dudhi. That section of the road between Chopan and Dudhi goes by the name of the Solah Koswa Road and is just 32 miles long.

Reference to the accompanying map shews that the road takes a line pretty nearly on the watershed of the trapezium formed by the Kunhar and Rihand Rivers, both of which flow into the Son.

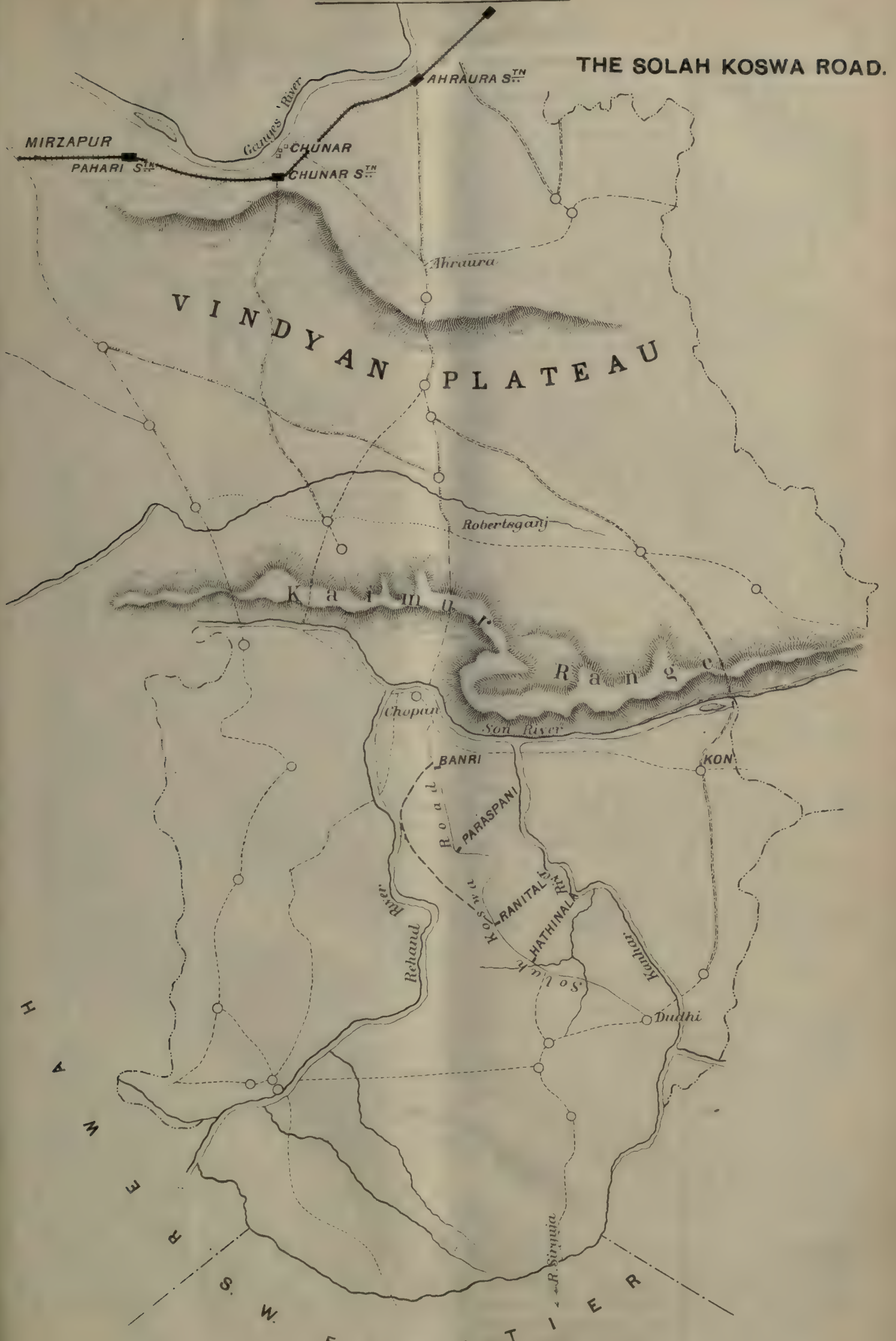
The lateral slope of the ground on either side is excessive, and numerous deep depressions render the road extremely arduous for travelling. The strata consist of shale and slate in almost vertical layers, interspersed with occasional bands of gneiss.

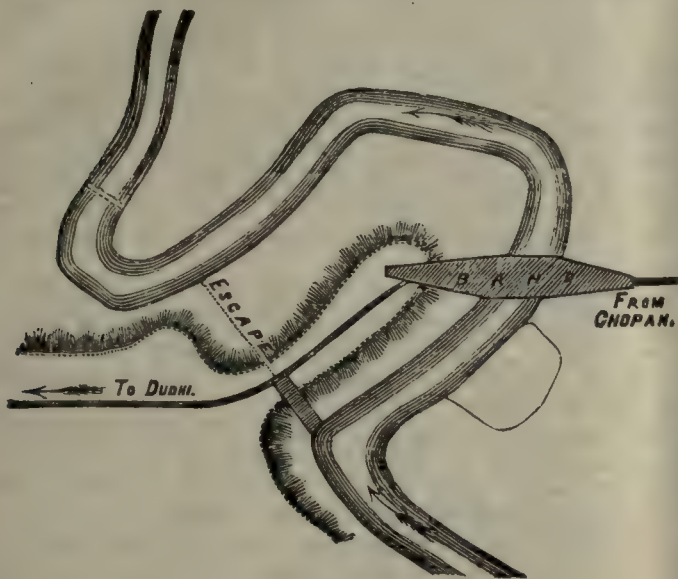
Traffic is necessarily suspended during the rainy season, the nalas and rivers being in full flood, and of the remaining eight months only four are available, as by March the water-holes in the nalas have all dried up, and the road is consequently absolutely deserted except by dâk runners. This state of things very seriously handicaps the trade, not only from Dudhi, but from Sirguja and beyond, which has then to take a long detour *via* Kon to reach Chopan (*vide*

sketch map). Some years ago the question of water-supply on this road was mooted, but nothing tangible resulted, until an Executive Engineer was specially deputed by Government to investigate the matter and suggest proposals. This gentleman's report contained the following:—1st.—That wells were quite impracticable owing to the nature of the strata. 2ndly.—He proposed forming tanks along the road at different points to impound the rain water, and also he strongly advocated the abandonment of the old line, all the way from Rani Tal to Banri, diverting it on to the banks of the Rihand. The reason given for this was, that he had doubts whether a proper permanent water-supply could be obtained at Paraspani, one of the main paraos on the road, and the most important point on the whole line, as when water fails here the road is useless. This report was duly printed and circulated, and eventually application was made to Government to send an experienced native subordinate from the Irrigation Branch to carry out the works. This was done, but the selection of any subordinate for such a work was a most unfortunate mistake. The plans and proposals submitted were of the very roughest and crudest description—mere outlines in fact—and to work these up and to give any opinion at all on the subject was quite beyond the powers of a native Supervisor, who had never acted, except in a subordinate position, and naturally did not possess the requisite technical knowledge. The idea seemed to be that these works could easily be carried out by the Estate Manager, with just a little professional supervision. As might be expected, the native Overseer did absolutely nothing besides draw his pay and travelling allowance, and was nearly frightened to death by the *feræ naturæ* who abound in these jungles. He was then sent back. Matters now remained in abeyance for some further time, until in 1885 the Lieutenant-Governor came down as far as Chopan on a shooting expedition. The question was then again brought forward by the Collector, and the author of this paper was eventually ordered to give his opinion on the original project and to draw up plans and estimates as the work was to be commenced immediately. Mr. Dale, the Collector, was from the first very much against the proposed diversion of the road, and the main point to be definitely ascertained was, whether a permanent water-supply at Paraspani was practicable or not. The works finally decided upon, and which were carried out last cold season, consist of two overfall weirs built across the nalas at Haltu Nala and Tumba Ghaggi, and two earthen bunds at Rani Tal and Paraspani. The works still required to complete the system are a weir at Banri and a bund and tank somewhere between Haltu Nala and Dudhi. The originally proposed road diversion was abandoned. The main work of all was the Paraspani bund. The original proposal for this work was a *pucca* bund across the nala 7ft. high. This would have been perfectly useless, as the slope of the bed of this nala averages 30 or 40ft. per mile. The design carried out is shewn below. The nala here takes a very sharp bend round a projecting spur of rock. An earthen bund 30ft. high was thrown across at the apex of the bend and an escape was cut through the rocky neck of land, the level of bed of escape being 20ft. above normal bed of stream. Thus 20ft. of water would be impounded. It was anticipated that the natural rock in the escape would be of so solid a description that further defensive works, on the downstream side, would be unnecessary. This turned out to be the case. The rock was very hard slate which was got out with considerable difficulty. The down-stream side was left absolutely unprotected artificially, the water being allowed to cut away the loose rock and soil, back to the solid hearting, thus forming a natural overfall. This work was thoroughly tested last rains when the rainfall was unusually heavy and concentrated. A natural fall of several steps was formed, the solid rock in the body of the hill being left intact. The construction of the earthen bund presented considerable difficulty. There are no villages within many miles of the site,

INDIAN ENGINEERING.

THE SOLAH KOSWA ROAD.





and the drinking water, unless the cold weather rains fell, would not last many months. There was no water available for puddling purposes, and work could not be commenced till the end of November when the *khari* harvest was over.

The first few feet of the bund were thrown up of damp clay well rammed, and after this dry soil of a sandy description had to be used. This was carefully added in layers till the bund had attained a height of 12 feet when a heavy fall of rain took place and brought the nala down in force. It rapidly rose against the embankment and was on the point of overtopping the bund when it gave way by being undermined in the deepest spot. The dry earth being full of air, the water gradually found its way, causing subsidence and eventually failure. It was very clear that no dry earth bund would stand against so sudden a rise of water. The current was allowed to run through the gap until the mass of the impounded water had escaped; it was then closed and the water allowed to rise against it again. Unfortunately the next night another terrific storm burst; this again forced the gap and widened it very considerably. The same tactics were again pursued; the gap with a great deal of trouble was again closed on the up-stream side; and the impounded water began, as before, to rise slowly behind the bund, till it attained a height of about 8ft. We had by this means secured a fine supply of water, which was utilized during the progress of the work at first to thoroughly wet the interior of the existing bund. This was effected by digging deep longitudinal trenches on it, the earth of which went to fill up the remainder of the gap and by keeping these trenches full of water for a week or more, a great deal of subsidence of the dry earth naturally took place, and the whole of the old work became thoroughly soaked.

The gap was closed with great care. First a bund was thrown across the down-stream end, and water admitted into the small tank thus formed. Earth was then thrown in and this process repeated, and the sides also pulled down till the gap was filled up level, being composed entirely of mud. The trenches were then filled, earth being thrown into the water and the whole surface brought up level.

The system then pursued was to form irrigation *kiyaris*, or small bunds, a foot high longitudinally and crosswise, dividing the surface of the bund into a chess board pattern; these were filled with water and kept full, and then earth was thrown in level to the top of the *kiyaris*. No ramming was done, the clods only being broken up as they fell in. When level the process was repeated, and by this means the whole bund was formed of wet earth, which was squeezed down by the weight of the

successive layers. In case of further rainfall, a temporary escape was dug on one side, as the real escape was not only unfinished, but its level was too high to be of any use till the final completion of the work. Fortunately no more rain fell, and the bund was completed to the full height just before the *Holi* festival when the *rabi* harvest commenced and not a man could be induced to remain. The escape cutting was not finally dug through till May. The water was raised on to the bund by means of three series of basket ladders, and it was a matter of some difficulty to ensure the thorough soaking of every course regularly, without interfering with the earthwork. The earth was supplied by petty contractors, and most of it was taken from within the reservoir, thus very much enlarging its area. The impounded water reaches for a mile up the stream and forms so large and deep an area between the escape and bund as to form a permanent and inexhaustible reservoir.

In the Rani Tal bund the conditions were more favorable, the bund was across a small ravine close to and below an existing tank; water for puddling was obtained by lifting it out of the tank and running it by a channel on to the new embankment, which was formed exactly in the way described for Paraspani. The catchment area of this tank is just sufficient to keep it well filled, the water escaping by means of a cut through the shale in the hill-side being very small in quantity. The area of water impounded is not a tenth of that at Paraspani, but it has this indubitable advantage that very little silt is brought into the reservoir, whereas all the other works are situated on *nalas* which run continuously during the rains and must deposit silt in large quantities. At Paraspani the area is so large, and the bund at such a distance from the escape, that it is improbable that it will ever silt up to that extent as to destroy the utility of the work. In the case of the *pucca* weirs constructed over the Haltu Nala and Tumba Ghaggi Nala, there can be no doubt but that scouring sluices will be constructed to keep the reservoir clear of silt. These sluices will be constructed through the hill side on the flank of the weirs and can be undertaken at any future time.

The *pucca* weirs present no features of interest, being very ordinary works. They consisted of a crest some 15ft. above bed level, flanked by high wings on each side, which runs into the rocky bunds of the *nalas*.

W. G. B.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

XXV.

Trap Stone Pavement.

Items per 100 s. ft.	No. or Quantity.	Rate.	Amount.	Total.
(1)		(3)	(4)	(5)
<i>Labor.</i> —				
Masons, Setting No. ...	14	Variable.	Do.	Do.
" " Dressing " ...	24			
Coolies " ...	5			
" " " ...	3			
Bhistie " ...	1			
Grinding mortar, c. ft.	10			
Sundries	...			
<i>Materials.</i> —				
3" to 5" thick stones's. ft.	105			
Quarry chips c. ft. ...	5			
Lime, dry powder ,, ...	4.8			
Sand ,, " ...	4.8			
Surkhi ,, " ...	4.8			
Sundries	.....		
Petty Establishment	.....		

PROPERTIES OF FLUIDS.

By A. EWANK.

I.

THESE papers will be elementary and are intended for such students as had their needs consulted in the papers on the "Principles of Mechanics." Those papers might with more fulness of definition have been thus entitled—"Some Principles of the Mechanics of rigid bodies." For in those papers all the bodies to which reference was made were what are ordinarily called rigid. A bar of cast-iron, of any length, but so thick, that under the strain of the forces which we ordinarily employ it would not perceptibly bend—such a bar may represent what we mean by a rigid body.

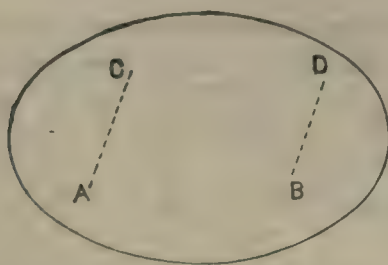
Thus one of the principles to which we appealed as a self-evident truth was as follows: A and B are two points of such a rigid body. At A is applied a force in the direction B A produced. At B is applied an equal force in the direction A B produced. Then these forces destroy each other. If a pair of such forces occurred among a number of forces acting on the body, we forthwith dropped this pair out of the list and proceeded to calculate what effect the other forces might have. Or we proceeded to neutralise others, taking no account of that dropped-out pair.

Now such reasoning tacitly admits that the body is rigid. Strictly that pair of equal forces acting at A and B would stretch the material between A and B and this stretching might induce other changes in shape. For instance, if we applied two such forces to a band of India-rubber we should see the length of the band, between A and B, increase. But we should also see that the band between A and B became narrower. If to a body ordinarily called rigid we apply equal and opposite forces there may be, and there will be, a slight elongation of A B. There may also be some consequent contractions in directions perpendicular to A B. In our former series of papers we did not deny the possibility of these changes of shape.

But if such changes did exist they were so small as not to be noticeable without extreme care. Moreover, we were not studying the question of the influence of force on a body in changing its shape. We only studied the influence of force in making the body as a whole take, or tend to take, motion in some one direction. In other words, we asked whether the separate particles of the body would move or tend to move all in lines which were all parallel.

Here again we see that our mathematical reasonings might be neglecting certain small quantities if the body under the action of certain forces did actually move. For if a body did move under the action of a system of forces and did in ever so small a degree simultaneously change its shape then the movements of all the particles of the body could not be exactly equal one to another both in direction and magnitude.

Fig. 1.



For instance, *fig. 1* let a body so travel that a point A of the body moves to C, a certain other point of space, and a point B of the body moves to D, a certain other point of space. Then if the body has also changed shape we cannot be sure either that $AC = BD$ in length or that AC is parallel to BD .

In dealing with such bodies as we had in the "Principles of Mechanics" we sometimes imagine a body to be perfectly unchangeable in size and shape, but easily capable of being moved as a whole. In such a case AC is both

equal and parallel to BD . Such a body, however, is an ideal body for we know of no such bodies in nature. Our reasonings on the "Principles of Mechanics" in cases where the body does not move did not imply such unchangeability. These reasonings are therefore valid for such ordinary imperfectly rigid bodies as we have in nature. If our reasonings had implied such unchangeability of size or shape they might still be approximately true for imperfectly rigid bodies. But then we must with each particular body examine into the closeness of our approximation.

We come now to a very different class of bodies. These are bodies that are neither perfectly quite rigid nor nearly quite rigid. They exhibit in fact a quality that is a sort of opposite to rigidity. That quality we might define as fluidity. To a body of this new kind we could not imagine two such equal and opposite forces (as above-mentioned) to be applied at points A, B of the body, for the body under the action of two such forces would forthwith separate into two or more bodies.

We might, however, supply the fluid body with some case or envelope. Then if this envelope was itself sufficiently rigid we could exert various forces upon the envelope and might consider, as with bodies rigid throughout, what effects would follow or tend to follow. We are not at present required to suppose the existence of any such envelope. We wish to consider some of the qualities of this new type of bodies. Milk, oil, treacle, are examples of the bodies in question.

The commonest example is found in water. Water is also often the most convenient to use in experiments, not only because it costs nothing or because it can be had in large quantities, but because it is cleanly to use. Some of the fluids may be what is called greasy or sticky. Some may be corrosive, destroying the vessels in which we put them. Some may give forth unpleasant odours which may even be injurious to health. Some may be coloured and the nature of the fluid may be such that while it is fairly transparent in thin layers, it becomes opaque in thick layers. These various characteristics we mention not as to be in themselves the objects of our study, but because these qualities make the fluids less convenient for our experiments than is the ungreasy, uncorrosive, scentless, uncolored transparent water.

Some of the qualities of a fluid might be described as chemical and with these we have no dealings in the present papers. Other qualities we may call physical, but some only of these qualities will be considered. For example, we have nothing to do with the smell, taste or color of a fluid even if we agree to consider such qualities as purely physical. In fact, with only two physical qualities have we any concern. One is the heaviness of a fluid. This is sometimes called its specific gravity. Fluids differ greatly in heaviness. For instance, a cubic inch of one fluid may weigh more than twelve times a cubic inch of another fluid. Instead of the number twelve we might have mentioned a much greater number. The only other quality which we shall discuss is that quality called fluidity. This quality may be described as mobility of the separate parts or particles of the body. Sometimes a particle is called a molecule. We may also define fluidity as "indifference to shape" or to any particular shapes.

Now just as bodies differ in heaviness—for a cubic inch of water has not the same weight as a cubic inch of kerosine oil—so the fluidity of a body is something that admits of degrees. Thus we might say one body is more fluid than another body, or such a body is imperfectly fluid. This variable degree of fluidity may be defined or illustrated by saying that one body changes its shape with greater readiness or quickness than does another body.

We may imagine that if equal efforts be used to two bodies, one body will more quickly change its shape, or we may imagine that the least forces necessary to make

two bodies change their shapes are not equal forces. Both these are rough methods of defining the variability of fluidity. Nevertheless, if these methods set the student on the right track of thought till he himself is induced to demand more exact definitions or illustrations, the methods will have served their purpose.

Let us pour a pound of water into an oilskin bag. Let the bag be not quite filled and let the bag be then closed. Then a slight pressure will make the water change its shape. If we now pour an equal volume—not necessarily of equal weight—of another fluid into a bag of equal size we may find that this new fluid does not with the same facility assume various shapes. For example, if we try treacle, this body will certainly yield, but will yield more slowly to the same pressure that we applied to the water. Nevertheless it does decidedly yield, and this yielding is an exhibition of fluidity.

NOTES FROM HOME.

(From our own Correspondent).

THE International Railway Congress recently received a Report giving a very important *resumé* of the different systems of electric lighting of trains. These are divided into four, namely: (1) Primary batteries. (2) Accumulators or secondary batteries placed in (a) the van, (b) or in each car so as to render the lighting independent. (3) A dynamo electric machine connected with one of the axles with accumulators to keep up the lighting when the train is at rest: and (4) A dynamo operated by a special motor placed on the locomotive or the baggage car and supplied with steam from the engine or a special boiler. Details of these systems and of their several adoptions are then given. The first of them seems to have been in partial use on the Midland, Great Northern, South Eastern, and London and South Western Railways. The cost is unknown, but from the fact that the battery has not come into extensive use, it is presumed that it is too high. The Brighton Company tried the second system and it is spoken of as the one with the best chance of success. The Brighton Company has also made experiments with the third system, but has abandoned it. Experimental trials of the fourth system have also been made on the Brighton line, but it is said to be too costly for ordinary trains. Details are given of various trials of these several systems on Continental railways, and though they demonstrate the possibility of lighting trains by electricity, they do not shew that the most practical system can be pointed out or defined. In conclusion, electric lighting appears too expensive, except in special cases, where its use is justified as a luxury and the expense is only a question of secondary importance.

A special passenger service between London and Paris will shortly be started, by which the journey each way will be covered in seven and a quarter hours. A "club train" will be run daily from London, and another from Paris, both starting at four in the afternoon and arriving at a quarter-past eleven. Dinner will be served and luggage examined during the journey. Arrangements for this service have been made by the English Railway Companies with the Northern Railway of France and the Wagons-lits Company.

A feud is now going on between the managers of three of the Southern Railways here, which, if not soon mended, must inevitably terminate disastrously for the proprietors in the several concerns. In the first case, the South Eastern Railway and the Brighton Railway are at cross purposes concerning running powers, and the latter Company being in sole possession of the suburban traffic promise to defend themselves if such traffic be attacked by their opponents. Meantime, the South Eastern and the Chatham and Dover Company are busily engaged in fighting over the development of the Continental traffic, all the details and the history of which are beyond the compass of your "Home Letter;" but it is patent to all observers that unless a fusion or a working agreement or some common policy can be accepted by these three companies their proprietary will not only suffer by a ruinous competition, but the public interest, safety and comfort will be in the result imperilled. Prior to the approaching meeting of the South Eastern very strenuous efforts are being made to turn out the Chairman, Sir E. Watkin.

By a recent return it appears that in the past twelve months the Railway Companies and the Grand Junction Canal brought into London 7,327,770 tons of coal. This is about $2\frac{1}{2}$ per cent. more than in the previous year. The seaborne coal brought into the Port of London amounted to 4,726,278 tons, being an increase of 55,171 tons or about $1\frac{1}{4}$ per cent. The price of coal in the London market has again been low during the year; the average price including City dues being only 16s 3d per ton.

Statistics are published in the *Gas World* of the gas supply to the metropolis during the prevalence of the fogs last week. From these it appears that one company, the premier gas company of the world, manufactured and sent out to its consumers in three days 298,700,000 cubic feet, or 42,000,000 above the quantity delivered on the same day last year. It may be interesting to know that the gross value of the total quantity at 2s 9d per thousand cubic feet is upwards of £41,000, while the value of the excess alone is £5,775. Another company sent out in four foggy days 37,985,000 cubic feet as against 33,164,000 on the corresponding days of last year.

It is said by the *Moniteur* that Admiral Olové, late Minister of Marine, is supported in his scheme of constructing a bridge across the English Channel by several leading French Engineers. It is proposed to rest the bridge on concrete piers. The height of it is to be 40 metres, thus enabling the largest ship to pass underneath it, and it is to be built of iron from the Great Creusot Steel Works. It is to start from Cran aux-Reefs south of Cape Grisnez and run on a straight line to Folkestone, the distance not being the smallest, but offering the least depth of water. The *Moniteur* goes on to say that the present French Minister of Works is in favor of the plan and is already taking steps to induce the English Government to assist in carrying out this gigantic scheme.

Major Hector Tulloch, R.E., has been appointed to the Chief Engineering Inspectorship of the Local Government Board in succession to Sir Robert Rawlinson, K.C.B., resigned. Major Tulloch's principal work has been carried out in India as his career there commenced in 1856. He carried out important work in Madras, and in 1870 was appointed Municipal Engineer to Bombay, where he executed works of peculiar difficulty in connection with the Vihar reservoir. The work was carried out with complete success and it was followed by his elaborate investigation of the improvement of the water-supply to Bombay. Major Tulloch, since his return to England, has filled very responsible offices, and has been an Inspector to the Local Government since 1873.

MATHESON & GRANT'S HALF-YEARLY ENGINEERING TRADES' REPORT.

(Continued from page 98.)

SCRAP IRON AND STEEL.—Prices are, as usual, largely influenced by the condition of trade in the United States. There is little doing or promising with the Atlantic ports, but there have been considerable shipments of scrap to San Francisco at 46s. to 47s. free on board. Holders of old iron rails will not sell at the prices, \$21 duty paid, ruling in New York equal to about 56s. payable here for cost, freight and insurance. Italy has been the best customer during the last few months, there having been large shipments thither of old rails and other scrap, but at present the demand has ceased pending the decision of the Italian Government as to a proposed additional duty of 10 lire per ton. The prices of mixed sections of old iron rails for Italy have been from 67s. to 70s. inclusive of freight ranging from 10s. to 13s.

IRON AND STEEL SHIPBUILDING.—A marked recovery has taken place during the last few months from the depression of the preceding three years, and this improvement is the most significant sign that a general revival has at last commenced in the Engineering trades. In Scotland shipbuilding reached its maximum in 1884, when nearly half a million tons were launched; freight rates rapidly fell under the increased competition of ship owners, and in 1886 less than 200,000 tons were built. Although the recovery has come too recently to influence much the statistics of the year just closed, the contracts entered into since September aggregate a greater tonnage than has ever been given out in a similar period. Steel has at last entirely superseded iron as a material of construction for steamers, for while in 1879 only 10 per cent. of the total vessels built were of steel, in 1887 the proportion was 80 per cent., and the remainder were almost entirely sailing vessels. In boilers the same revolution has taken place; steel allows the higher pressure of steam which is essential to economy of fuel, and further progress in this direction is going on. Triple expansion has been successful with steam at 150lbs. pressure, but the same principle carried out by quadruple expansion will be still more advantageous if an initial pressure of 200lbs. be given in the first of the four cylinders. This is likely to be the maximum till invention takes a new departure.

STEEL AND IRON BRIDGES.—All the principal factories have been fairly well employed during the past year, but prices have been, and still remain, at a level leaving only the barest profit. Mild steel with a tenacity ranging from 27 to 32 tons per inch is now accepted as the best material for bridges, and although not yet used much for spans

under 100 feet, and hardly at all for roofs, its universal adoption cannot much longer be delayed. At home the Forth bridge is making rapid progress, and, as far as exceeding in magnitude all other structures in the world, is receiving the attention of Engineers everywhere. The superstructure of the Tower bridge will be commenced this year, and smaller bridges over the Thames, the Dee, and other rivers are in progress. There is, however, little new work of this kind, and it is in bridge widening, station extensions and additions to old structures that most of the home expenditure is applied. This branch of trade depends mainly on export, India, South America, Japan, and more recently China, being the countries which have given employment during the past year. English Engineers still prefer riveted bridges. American designers are approaching nearer than formerly to English solidity and methods, and in weighing the respective merits of pin connections and rivets, it must be taken into account that the improved workmanship in this country, the planed abutting edges, drilled rivet holes, and hydraulic riveting enhance considerably the advantage of the English system, and render it more than ever preferable against the severe stresses of modern railway traffic.

MECHANICAL ENGINEERS may anticipate a year of active trade. Not only in the leading branches are there more enquiries leading to actual results, but also in the subsidiary trades which have so long been dull because of the great depression in the great industries of the country. The revival of shipbuilding gives employment to numerous trades engaged in the minor equipment of vessels, while machine-tool makers are finding a renewed demand for the multifarious appliances used in Engineering factories. The probable abolition of the sugar bounties tends to a recovery in the sugar-growing colonies which formerly bought so largely from this country; the manufacture of steel-making plant is now a well established specialty; and arsenal machinery is in demand for foreign governments. Improved systems of pumping are being adopted by which direct-acting pumps are rendered more economical by improvements allowing the expansive use of steam, an economy which has hitherto been wanting in this class of water-raising machines. Power transmission by water and compressed air are each being tried on an extended scale, and the coming year is likely to resolve the question of their comparative merits.

LOCOMOTIVES AND ROLLING-STOCK.—During the past year there has not been the extreme depression which in 1886, brought many firms to the verge of collapse, but with few exceptions manufacturers have had during 1887 to work for very little profit. The large factories of the Railway Companies are still the great hindrance to improvement at home, but the prospects for foreign orders are better than they have been for the last few years. India, Burma, the Colonies, South America and Japan have been the chief sources of employment, and the enquiries now coming forward justify expectations for the immediate future, although it will be sometime before prices improve beyond what may be due to the higher cost of material. There is great activity in the United States; car builders are particularly busy there, and this reduces the competition of American makers in neutral markets. Compound engines with various adaptations of the three cylinder principle are slowly growing in favor, while in carriages the use of steel in the under frames is being more widely applied. The manufacture of train cars and tram engines now forms an important adjunct to this branch of the Engineering trades. The variety of air brakes adopted by the different Railway Companies is still a cause of inconvenience in the making up of mixed trains, as it renders necessary numerous different fittings on the vehicles. The question of continuous brakes for goods trains is receiving much attention in the United States, the length of the trains and the greater looseness of the couplings than in passenger trains requiring instantaneous action, not obtainable by any system at present working here.

MINING ENTERPRISE has been particularly active during the past year, the gold discoveries in the Transvaal, where already five millions of paid-up capital are invested, being the most notable example. The great rise in the values of copper, tin, lead, and other metals has stimulated the development of mines neglected of late years as well as those in new districts, and it appears likely that silver, which has fallen in price so continuously during the last few years, will also share in the general advance. Although the permanence of this revival cannot be predicted, Engineers are reaping an immediate benefit, those who have had experience in mine management finding employment in prospecting and working the minerals, and manufacturers in the supply of mining plant. Improvements in gold separating appliances and those connected with the extraction of copper, allow the profitable treatment of poor ores, and to these improvements English inventors have contributed their full share.

ELECTRIC LIGHTING has made real progress during the past year. In many of the large towns central stations are being established from which users can buy at prices really cheaper than that of gas if measured by the advantages obtained, while manufacturers with boiler power available find that they can produce the electric light at an actually less expense than gas. The system of transmitting electrical energy long distances by currents of high tension and reconverting it into low tension currents for house to house distribution has made considerable progress. Miners' safety lamps worked by small portable accumulators have proved successful, and the principle is likely to extend to other cases, although for general use the cost is at present prohibitory. Schemes are from time to time brought forward for producing the electric light from primary batteries instead of by mechanical force exerted through a dynamo, but except for very special cases they are entirely fallacious, and serve only as a snare for investors.

The keen competition of manufacturers during the last few years has brought into prominence the geographical advantages and drawbacks of different localities. Contiguity to a port of shipment is of increased value in those trades where weight bears a high proportion to value, and the midland districts are subject to charges which handicap them heavily. The ship canal to Manchester, those projected from the Trent and the Severn to Birmingham, the construction of the Barry Docks, the improvements at Milford, Barrow and Preston, are all attempts to overcome a similar difficulty.

LONDON; January 2, 1888.

The Gazette.

PUBLIC WORKS DEPARTMENT.

Mysore, February 4, 1888.

Mr. J. B. Chalon, Assistant Engineer, is granted furlough for 15 months under the Civil Leave Code, with effect from the forenoon of the 25th October 1887. The privilege leave for 3 months granted in Notification, dated 21st November 1887, is hereby cancelled.

Madras, February 7, 1888.

The following promotion is made:—

Mr. J. Hannan, Executive Engineer, 1st grade, in charge of the II. Circle, to be Superintending Engineer, 3rd class, temporary rank, during the absence in England on special duty of Lieutenant-Colonel J. Pennycuik, R.E., or until further orders.

The services of Mr. C. A. B. Target, Executive Engineer, 1st grade, are replaced at the disposal of the Government of India, Public Works Department.

M. R. Ry. S. Subharaya Chariyar Avargal, Rai Bahadur, Executive Engineer, 3rd grade, sub. *pro tem.*, is granted leave on medical certificate for two months from the 15th January 1888.

The following postings are ordered:—

Amrito Lal Roy Chowdry, Rai Bahadur, Executive Engineer, 2nd grade, Bengal, to the charge of No. III. Party, Tank Restoration Scheme, Kurnool. To join on arrival.

Mr. W. Jopp, Assistant Engineer, 1st grade, to the VI. Circle, for charge of the Ramnad Division. To join on return from furlough.

Mr. W. Knowles, Assistant Engineer, 2nd grade, is declared to have passed, on the 19th January 1888, the Professional Examination prescribed in the Public Works Code and the Colloquial Examination in Telugu.

The following promotions are made:—

Mr. W. Jopp from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from date of assuming charge of Ramnad Division.

Mr. W. Knowles, Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, permanent rank, with effect from 19th January 1888.

The following honorary promotions are made with effect from 1st February 1888:—

Mr. J. D. Legge, Sub-Engineer, 2nd grade, to be Assistant Engineer, 2nd grade, honorary rank.

Mr. S. Francis, Sub-Engineer, 2nd grade, to be Assistant Engineer, 2nd grade, honorary rank.

Bombay, February 9, 1888.

Mr. G. O. W. Dunn, Executive Engineer, 4th grade, is allowed furlough, under section 50 of the Civil Leave Code, for fifteen months, with the usual subsidiary leave, from such date in March next as he may avail himself of it.

Punjab, February 9, 1888.

Mr. C. Roberts, Assistant Engineer, 2nd grade, attached to the Kohat Provincial Division, passed the Departmental Standard Examination prescribed in the Public Works Department Code, on the 28th October 1887.

Mr. C. H. Barratt, Executive Engineer, 4th grade, temporary rank, attached to the Rawalpindi Provincial Division, is allowed one year's furlough to Europe under the Civil Leave Code, with effect from the 1st April 1888, or such subsequent date as he may avail himself of the same.

Central Provinces, February 11, 1888.

Mr. D. Wallace, Executive Engineer, 2nd grade, on special duty, is posted to the charge of the Eastern Division, with effect from the forenoon of the 22nd ultimo.

India, February 11, 1888.

Rai Sahib Dharm Sing Soin, Assistant Engineer, 1st grade, temporarily employed in the Punjab, is permanently transferred to that Province from the Local Administration List.

Lieutenant Philip Geoffrey Twining, R.E., is appointed to the Department as an Assistant Engineer, 2nd grade, and posted to State Railways. Lieutenant Twining is placed at the disposal of the Director-General of Railways.

The services of Mr. R. T. Denne, Executive Engineer, 4th grade, temporary rank, State Railways, temporarily employed in Baluchistan, are placed at the disposal of the Bengal-Nagpur Railway Company.

Mr. C. J. K. Watson, Executive Engineer, 3rd grade, Bengal, is temporarily transferred to the Accounts Branch, with the temporary rank of Examiner, 4th class, 3rd grade, and is posted to the Office of the Examiner of Public Works Accounts, North-Western Provinces and Oudh.

Lieutenant-Colonel W. J. Engledue, R.E., Executive Engineer, 1st grade, State Railways, attached to the Office of the Consulting Engineer to the Government of India for Railways, Calcutta, is granted special leave for one year, under the terms of Public Works Department letter, dated 3rd October 1887, with effect from the 15th March, or from such date as he may avail himself of it.

Captain R. O. Lloyd, R.E., Executive Engineer, 2nd grade, on return from field service, reverted to the Public Works Department, with effect from 2nd February 1888.

Mr. C. A. B. Target, Executive Engineer, 1st grade, Rajputana, temporarily employed under the Madras Government, is transferred to Burma Provincial Establishment.

Rai Amrito Lall Roy Chowdry Bahadoor, Executive Engineer, 2nd grade, Bengal, is transferred temporarily to Madras.

The services of the undermentioned officers are temporarily, placed at the disposal of the Punjab Government for employment on the Patiala-Bhatinda Railway :—

Mr. W. A. Lesmond, Executive Engineer, 2nd grade, State Railways.

Mr. R. L. Campbell, Executive Engineer, 4th grade, sub. *pro tem.*, State Railways.

Military Works Department.

Lieutenant J. W. Pringle, R.E., Assistant Engineer, 2nd grade, passed the colloquial examination in Hindustani required by Public Works Department Code, on the 17th January 1888.

Director-General of Railways.

With reference to Public Works Department Notification dated 2nd February 1888, Mr. C. J. S. Baker, Executive Engineer, 4th grade, sub. *pro tem.*, is posted to the North-Western Railway.

Mr. G. F. Thompson, Assistant Engineer, 2nd grade, passed the Lower and Departmental Standard Examinations in Hindustani, as prescribed in Public Works Department Code, on the 2nd and 16th January 1888, respectively.

Bengal, February 15, 1888.

Establishment—General.

Mr. J. C. Hewitt, Assistant Engineer, is transferred from the Jessore to the Hazaribagh Division.

The Lieutenant-Governor is pleased to make the following promotions and reversion in the Engineer Establishment, with effect from the dates specified :—

Mr. C. A. Mills, from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 28th December 1887.

Mr. J. C. White, from Executive Engineer, 4th grade, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 28th December 1887.

Mr. J. T. Boase, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 28th December 1887.

Mr. A. H. Mason from Assistant Engineer, 1st grade, to Executive Engineer 4th grade, temporary rank, with effect from 28th December 1887.

Mr. T. Butler, from Executive Engineer, 4th grade, temporary rank, to revert to Assistant Engineer, 1st grade, with effect from 2nd February 1888.

Mr. B. E. Carter, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 2nd February 1888.

Establishment—Irrigation.

Mr. T. Butler, Assistant Engineer, attached to the Brahmini-Byturni Division, is allowed furlough for nine months from the 25th instant.

Mr. O. C. Lees, Executive Engineer in charge of the Circular and Eastern Canals Division, is granted furlough for nine months from the 10th March 1888.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 8th February 1888.

- 100 of '87.—The Lartigue Railway Construction Company, Limited, of No. 10, Drapers Gardens, in the City of London, England.—For improvements in single-rail elevated railways and vehicles therefor.
- 101 of '87.—The Lartigue Railway Construction Company, Limited, of No. 10, Drapers Gardens, in the City of London, England.—For improvements in locomotives for single-rail elevated railways.
- 182 of '87.—Charles Arthur Turtton, Tea Planter, of the Lukwah Tea Company, Limited, Upper Assam.—For improved methods and appliances for withering tea leaf.
- 5 of '88.—Alexander McCulloch, 6, Panmure Street, Dundee Civil Engineer, Alexander Carrie, Baldragon, near Dundee, Spinning Overseer, and David Oglive, of West March, Monifieth, near Dundee, Mechanic, all in the county of Forfar, Scotland.—For improvements in machinery for spinning or twisting fibrous materials.

East Indian Railway.

SALE OF SURPLUS AND CONDEMNED STORES comprising cargo and other boats, scrap iron borings, scrap, cast and wrought iron, scrap steel, brass, and copper, mixed metal borings and sweepings, old iron and steel rails and crossings, old wheel centres with steel tyres, iron skeleton wheels, steel axles, locomotive driving wheels with crank axle, steel wheels and axles for colliery tram-trucks and iron colliery tubs, wrought iron girders, iron spikes, steel fish plates, roofing tiles, fire-bricks, miscellaneous firewood, firewood sleepers, &c. &c. &c.

Tenders will be received at the office of the Controller of Stores, East Indian Railway Company, Fairlie Place, Calcutta, up to noon of Wednesday, the 29th February, 1888, for the purchase of surplus and condemned stores as above, at Howrah, Giridih, Asansol, Jamalpur, Dinapore, Allahabad, Cawnpore, Ferozabad, Tundla, Agra Junction, Bhandai, and Ghaziabad.

Tenders must be submitted in the form to be obtained at the office of the Controller of Stores, where printed lists of the stores can also be had, and tenders submitted in any other way will not be considered.

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D. W. CAMPBELL,

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Calcutta, January 27, 1888.

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CALCUTTA :
11th February 1888. }

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PORT OFFICE, BOMBAY; }
January, 18 1888. } Port Officer of Bombay.
(64)

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A. L. SANDEL,
VICE-CHAIRMAN,
District Board, Pooree.

DISTRICT BOARD'S OFFICE, POOREE, }
The 7th February 1888. }

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[29]

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Of Ceylon

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(44)

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ANSWERS TO CORRESPONDENTS.

"X." "W. G. BLIGH," "TUSSEER," and "PUBLIC HEALTH."—In our next.

"P. W. INSPECTOR."—Thanks; but the subject has been discussed dry in our columns during the past few months.

Several communications are held over for want of space.

INDIAN ENGINEERING.

SATURDAY, FEBRUARY 25, 1888.

INDIAN RAILWAYS: A RETROSPECT.

FROM the Administration Report of the Director-General of Indian Railways on the progress and present condition of our railway system, we find that on the 31st of March last the total extent of railways open for traffic in this country was 13,390½ miles, of which 4,538½ miles were managed by guaranteed, assisted, and other Companies, 7,952½ miles are State lines, either Imperial or Provincial, and 899½ miles belong to Native States. The extent of lines under construction was 3,205½ miles. The total capital outlay on railways and steam services connected with them on the last day of 1886 amounted to £170,498,911 (assuming £1 to represent 10 Rs.), of which £60,763,058 have been expended by guaranteed companies, £100,780,534 on State Railways, inclusive of £35,221,312, the cost of the East Indian Railway, £3,423,367 on assisted companies' lines, and £5,531,952 on Native State lines. The gross receipts during the year 1886 amounted to £18,704,536, compared with £17,989,625 in the previous calendar year; the working expenses were £8,930,983, as compared with £8,863,294 in 1885. The net revenue amounted to £9,773,553, of which the East India Railway, including the branches worked by the Company, contributed £3,133,232, the guaranteed lines £3,654,183, the assisted companies £124,003, the State lines (excluding the East Indian Railway and branches) £2,702,533, and the lines in Native States £159,602. The total net earnings on all the lines in 1886 shewed a return of £5 14s. 8d. per cent. per annum, as compared with £5 12s. 9d. in 1885, or leaving out of calculation steam-boat services and suspense, of £5 18s. 1d. as compared with £5 16s. 8d. On the other hand, including steam-boat service and suspense, the East Indian Railway and branches yielded £8 8s. 11d. per cent. the guaranteed lines paid £6 0s. 3d. per cent., the State lines, Imperial and Provincial, excluding the East India Railway and branches, paid £4 4s. 8d. per cent., the assisted lines, excluding the Tarkeshwar, £3 16s. 3d., and the Native State lines £2 17s. 8d. per cent. To prove how popular railway travelling is among all classes of the people in India, we have only to cite a few figures which speak significantly for themselves. In 1886 the total number of passengers carried was 88,436,318 as compared with 80,864,779 in 1885, and the receipts from the coaching traffic amounted to £5,793,152 as compared with £5,538,126. The aggregate tonnage carried has amounted to 19,576,365 tons as compared with 18,925,385 tons, and the earnings from goods traffic have amounted to £12,385,914 as compared with £11,915,375 in 1885. The summary of the principal articles of trade carried on all Indian railways shews an increase of 941,856 tons, or, excluding railway materials and revenue stores, the total weight carried has shown an improvement by 787,959 tons. It would be interesting to know how the several

lines have contributed to this result, we will therefore summarise the returns of the more important lines:—

ODDH AND ROHILKUND RAILWAY.—Owing to the harvest having been a short one throughout the provinces served by this line and those approximate to it, during the first half of the past year, the net receipts only fell short of the 5 per cent. guaranteed rate of interest by £466, and this result was attained in the teeth of a very considerable falling off in the goods traffic, the deficit, as compared with the corresponding half-year of 1886, being no less than £15,466. But for this unfortunate fact the profits would have exceeded the guaranteed rate of interest by a very large amount. Notwithstanding this falling off, there would still have been a small balance over and above the guaranteed rate, had not a sum of £6,516 been paid to the Secretary of State as "interest on overdrafts of capital accounts," and "interest on £500,000 advanced for payment of debentures from 22nd January to 26th March 1887," at 5 per cent. There was some disappointment in the matter of coaching traffic as a large accession to it had been anticipated. The gross decrease in the expenditure under the three principal heads of maintenance of way, works and stations, locomotive expenses, carriage and wagon expenses was £17,633 and the locomotive department alone is credited with £10,821 of this saving. In spite of a small increased open mileage of between 6 and 7 miles, the expenditure had fallen to 49·08 on gross receipts. The bridge over the Ganges at Benares, consisting of 7 spans of 356 feet and 9 flood openings of 110 feet, cost about £750,000. The Secretary of State has signified his intention of purchasing the line at the expiration of the first 20 years of the contract, viz., in December of the present year.

GREAT INDIAN PENINSULAR RAILWAY.—A dividend for the first half-year, which with the guaranteed amount will be equal to close upon 4 per cent. has been declared on this line. The ratio of expenditure to receipts has been brought to something below 40 per cent., a most satisfactory state of affairs, or as the Chairman put it at the last meeting, "is the best thing that has ever been done by a railway." The G. I. P. line has contributed nearly 47 per cent. to the total increase of all the lines in India. Colonel Conway-Gordon says: "this satisfactory result is attributed to the improvement recorded under goods Traffic, towards which the carriage of cotton, wheat, and railway materials mainly contributed." Wheat alone brought in £521,386.

There was an expectation that this wheat traffic would be constant. So far as the United States are concerned there is no cause for future anxiety, but Russia has sprung a mine on the importers in the United Kingdom and there were apprehensions that she would to a certain extent swamp the market. Even if it were so, there were other articles of trade to which the Great Indian Peninsula Railway might look forward with a certain degree of satisfaction. Cotton promises well. The item that has materially helped to swell the profits has been the carriage of railway material for other lines. It is satisfactory to note that every year old iron is replaced by new steel

rails, and in the half-year under notice 850 miles have been laid with steel rails. The latter last on an average from three to four times as long as the iron rails and cost very much less than the iron rails of the past generation.

INLAND MIDLAND RAILWAY.—If the country which has no history to record is a happy one this Railway Company ought to congratulate itself under the circumstances, for as the Chairman put it, there was "not much in the way of result at present beyond the fact that the construction of the line is proceeding in a rapid and satisfactory manner." The map of the line was referred to and all hopeful prophecies hazarded to which we need not refer here. The report laid before the Directors and representatives of the shareholders was one tinged with *colour de rose*, and may they realise it is our earnest prayer. In our next we hope to take up the other railways in turn.

THE MADRAS ADMINISTRATION REPORT, 1886-87.

THE total area of the Madras Presidency by latest estimate is 141,617 square miles; and topographical survey of 53,737 square miles has been completed. During 1886-87, 1,606 square miles were mapped on the scale of 16 inches to a mile, and 706 square miles on smaller scales. These figures are derived from the Madras Government's Administration Report for 1886-87, from which it is our intention to select and boil down such salient items of information as are likely to interest readers of INDIAN ENGINEERING.

Turning to the chapter on Public Works, we naturally find the Madras Harbour Works bulking large in the record, although the progress made with them was much less than had been hoped for. Still, an advance was made, and the new system of building and protecting the walls thoroughly started. The superstructure of the north pier was advanced by a length of 445 lineal feet, 645 concrete blocks having been used for this purpose, all thoroughly bonded together and secured by iron cramps to one another. In addition to this work, 828 blocks, representing 24,382 tons of concrete, were deposited in the wave-breaker on the sea side of the north pier. In the rubble foundations 98,560 tons of stone were deposited. The south pier superstructure was advanced by a length of 300 feet, 383 blocks being used in the construction. There were also 552½ blocks placed outside, to form a wave-breaker, and 16,242 tons of stone were deposited in the foundation. Much difficulty was experienced at the south pier in consequence of old blocks from the ruined work being thrown by the sea into the line of new foundations, but many of them were utilized in the wave-breaker. Concrete block-making progressed fairly well, and 2,151 blocks of different shapes were made. At Negapatam it is intended to fill in the abandoned boat basin, and to divert the town drainage from the foreshore. A scheme for the drainage and water-supply of the town is also mentioned as under the Executive Engineer's consideration. The Ootacamund water-works were carried towards completion during the year under review. Good progress was made on the work of

reforming the Calicut-Vayitri road; the big bridge over the river Vaigai at Madura was begun.

The total area occupied for irrigation was 4,882,913 acres, the total revenue assessed on irrigated lands was Rs. 2,28,35,766 as against Rs. 2,22,46,501 in the previous year. The Godavari river rose above the crest of the anicut on the 7th June 1886, and did not again fall below that level till the 22nd March 1887. Such a flood as that of July and August 1886 was never before known. In the eastern section the head lock at Dowlaishweram was destroyed, and for some time the head sluices were in great danger. Ultimately, the only masonry works injured were the Chopella lock, and the establishment sheds connected with it. The small amount of damage done by this abnormal, seemingly resistless flood attests the good quality of the works against which it vainly wasted its fury. The Periyar irrigation project, sanctioned by the Secy-tary of State for India three-and-a-half-years ago is still an embryo in course of being stifled by the ubiquity of "Financial pressure." 'Tis a pity. The object of the work is to utilize a portion of the superabundant rainfall on the western slopes of the ghâts for the purposes of irrigation in the district of Madura to the east of the water-shed, where the rainfall is comparatively scanty, and often very uncertain, and where famine has in consequence been severely felt on more than one occasion. It is proposed to accomplish this object by diverting to the eastern side of the ghâts the waters of the river Periyar, which rises on the western side, traverses the Native State of Travancore, and falls into the sea near Cochin. The head works for catchment of the water are to consist of a dam made of concrete, 155 feet in height above the deep bed of the river. From the reservoir thus formed the water will be passed by a subterranean aqueduct, 6,650 feet in length constructed through the water-shed ridge into the Soorooly, down which it will flow into the Vaigai whence its waters will be utilized for irrigation and fertilization of a hundred thousand acres of land.

As to Railway working we are told that the increase in the number of passengers carried on the Madras Railway was very marked, and that on the South Indian Railway the goods traffic shewed steady development throughout the line. There were no train accidents of a serious character during the year, and the only damage by floods of any importance occurred on the Madras Railway in November 1886 when two piers and three arches of the Swarnamukhi bridge were destroyed during a cyclone, and through communication was suspended for thirteen days. The bridge, which consists of nine 30 feet arches was supposed to have its foundations on rock. In which case, the report suggests, "the rock must have disintegrated sufficiently to become susceptible of erosion, as one of the piers was undermined and fell." With reference to the Tinnevely-Quilon Railway we are told that the Travancore Government have decided to adopt the northern route by the Arienkavu pass; but the required capital is lacking. The length of the proposed line is 106 miles, and its estimated cost on metre gauge Rs. 93,15,623.

No mineral traffic exists as yet on the open lines in the Madras Presidency. The Madras Railway imports patent fuel from England; the South Indian draws its supplies of coal partly from England, but to a greater extent from Australia. No Indian coal was used on either line in 1886, they were waiting for the opening of the line from Warengal to the Singareni coal field. The increased earnings of the Madras Railway are mainly due to transport of cotton, jaggery, and skins. *Apropos* of a falling off under the heading *Parcels*, we are told that it is due principally to the reduced demand for indigo consequent on the producers having mixed aniline dyes with it. It isn't only the heathen Chinese who is "pecooliar."

The cost of maintenance on the Madras line averaged Rs. 1,308 per mile of track. On the South Indian Rs. 1,942. This heavy charge was mainly due to renewal of the permanent way, which it has been decided to relay throughout with new material, consisting of 50lb. steel bull-headed rails on pot sleepers, at the rate of 10 miles per annum. The formation of pitched causeways to allow of the passage of extraordinary floods over, instead of under the line, has made good progress. Groynes have also been added in places where the line has been threatened by streams. Although abnormal expenditure had to be incurred on the works aforementioned, and although loss by exchange seriously affected the profit side of accounts, the earnings of the South Indian Railway shew an increase of upwards of 3½ lakhs of rupees over those of the preceding year. Nearly all this increase is due to the large development of goods traffic; and shareholders got a dividend at the rate of 3.15 per cent. on total capital expenditure.

Four hundred and forty-nine miles of telegraph lines were laid down in 1886-87, raising the total telegraph mileage in the Madras Presidency to 4,521 miles. The total number of offices open at the end of the year was 199, of which 108 are under direct Government management, and "of the remaining 91 only 30 carry public messages." Why this monopoly? It helps one to understand the perpetual fuss and friction that is a distinguishing characteristic of the Madras Government; but that aid to knowledge in no wise justifies what seems to us uncommonly like a misappropriation of public property. Is the greediness a legacy from the great Panjandrum Sir M. E. Grant-Duff, a dog-in-the-manger sort of prerogative which his genial successor knows nothing about. It looks uncommonly like a screw loose somewhere.

In Madras city, under Municipal dispensation, Rs. 1,71,759 were spent on the Black Town drainage scheme, Government contributing from provincial funds Rs. 1,00,000. No steps were taken to proceed further with the new water-supply scheme. Financial pressure again, we suppose. The lighting of the town with—Kerosine oil—was continued, and yet Madras objects to being called benighted! Expenditure on the People's Park amounted to Rs. 16,354, receipts to Rs. 3,757. In the Mofussil the right to elect their own Chairman was

"enjoyed" by 39 Municipal Councils against 40 in the preceding year, the Tanjore Council having been deprived of the privilege owing to failure in securing the quorum of members necessary for an election. And so now Tanjore enjoys peace and quietness instead of election squabbles.

MUNICIPAL ADMINISTRATION IN LOWER BURMA.

JACK BURMAN, ease-loving, happy-go-lucky mortal that he is, does not believe much in the beauties of Lokil Sluff, and infinitely prefers his otium with or without dignity to adjustment of Municipal ends to Municipal means, and getting wigged by some energetic English official by way of reward for the unaccustomed trouble he has taken. The Chief Commissioner of Burma is a masterful man, however, and determined that with Lokil Stuff Jack shall be saddled, whether he likes it, or whether he does not. Accordingly he decided last year to extend the Municipal Act of 1884 to certain towns "in spite of the reluctance of the people to be brought under Municipal Government." This quotation is taken from a Report on Municipal Administration in Lower Burma during the official year 1886-87, now lying before us. In it Rangoon is warned that its expenditure is increasing too fast; Moulmein is told that an official scheme is in course of preparation by virtue of which its solvency will be restored; Prome is referred to as having just been recovered from a state of insolvency; the Gyobingauk Committee is reproved for "reckless expenditure and unbusiness-like habits;" further on it is written that "in the Tenasserim division the condition of town funds was not satisfactory." Wherever there is a surplus of town fund income over expenditure, or something like equilibrium between the two, the result seems to have been achieved either by dint of large increase in the sale of liquor licenses, or by cutting down expenditure on public works. In neither case does the success recorded seem to us matter for congratulation. Judged by this Report, Burmese Municipalities seem anxious, first for schools, secondly to improve the material condition of their townships by means of expenditure on public works.

To teach them how to do so, gradually and with due regard to their ledgers, would surely be better than snubbing them, without pointing out any way of reform. Commonsense, at any rate, would suggest this as the most sensible plan to be pursued under the circumstances. But then, pursuance of such a plan would be unwarrantable interference with the cardinal principles of Lokil Sluff, we suppose. The Chief Commissioner may scold *ad lib.*, may suggest to untutored, finance unaccustomed Committees that "their first duty is to suit their expenditure to their income." And so forth. But he must not shew them how to, because that would be a treason to Lokil Sluff. Such fatuous, fetish-like worship of a name seems to us as silly as it is objectionable. Did the Chief Commissioner of Burma ever happen to hear the old apologue of the dog with a toothsome bone in his mouth who dropped it in the water, for the sake of a shadow?

Notes and Comments.

THE EXAMINER'S OFFICE, P. W. D., INDORE.—The Examiner's Office, Public Works Department, Indore, has orders to remove to Mount Abu, it having been amalgamated with that of Rajputana.

ALLAHABAD MUNICIPALITY.—A premium of Rs. 300 will be given for the best Plan and Estimate of a Town Hall to contain about a dozen compartments, including a Hall 50' x 30' and a 10½' feet Verandah all round, and cost Rs. 25,000.

INDIAN STATE RAILWAYS.—The Director-General of Stores for India is calling for tenders for the supply of girders for a 200ft. span. This may possibly be for the new Chenab Bridge of which we have heard so much of late.

BENGAL P. W. D. RAILWAY UNDER SECRETARYSHIP.—Mr. Spring goes to the North-Western Railway System about the end of next month for employment on the Chenab Bridge and Mr. Hebbert from the Consulting Engineer's Branch takes his place.

THE KHOJAK RAILWAY EXTENSION.—His Honor the Lieutenant-Governor of the Punjab visits Quetta on 3rd March and will inspect the new railway extension at the same time. Snow has now gone in Quetta, and is much diminished on the Khojak Railway. The work is progressing rapidly.

MORE RAILWAY ACCIDENTS.—There was a derailment at Mokameh Ghat on the 10th instant, owing to a pointsman putting an engine with some wagons on two lines. Thirteen wagons were damaged, some of them extensively, owing to the speed at which they were going. The pointsman has been arrested.

REMOVAL OF OBSTRUCTIONS IN THE IRRAWADDY.—Government officers are actively engaged on the Ngazoon rocks in the Irrawaddy in preparing to blast this great obstruction to the free navigation of the river near Sagaing. These rocks have caused a large number of wrecks and almost bar the Channel when the river is low.

BANGALORE WATER SUPPLY.—As we anticipated, the British President has declined to sanction the payment of Rs. 500 for General Fisher's scheme for supplying Bangalore with water, which was voted by a majority of the Commissioners, on the ground that it is inadvisable for the Municipality to make a precedent of voting public money for testing and elaborating the incomplete plans of private individuals.

INCINERATORS IN INDIA.—The Bee-hive destructor which has been at work in Bombay for the past six months has not proved an unqualified success. It has worked with satisfactory results in the dry season; but during the five months of the rains the refuse is soaked with moisture, and cannot be easily burned. During the wet months the cost of burning the refuse is high, and the work troublesome.

THE NEW DOCK, BOMBAY.—The new dock extension is sufficiently near completion to allow the water to be admitted. As the approaches, however, still require some dredging, the dock will not be formally opened, as we have said before, until about the beginning of April. We see from the excerpts of the proceedings of the Bombay Port Trust that it has been decided to call the new dock the "Victoria" Dock.

A DIFFICULTY.—Mr. C. H. Crowder, M.I.C.E., Executive Engineer, first grade, Superintendent of Way and

Works, N. W. R., Sind Section, will soon attain the age of 50 years, with a few months under 20 years' service in the Department, and will therefore be one of the first to come under the operation of the Retirement Scheme for Officers of the Public Works Department promulgated in October last. The course followed in this case will be watched with interest.

THE CONSULTING ENGINEER'S BRANCH.—Speculation is active as to certain impending changes. It is stated that Major Coaker wishes to get the Consulting Engineership, Madras, and a difficulty intervenes in Colonel Jopp, who is Departmentally the junior by a few months, though holding a higher Military rank and having four years longer service in the Department. This is ascribed to a break in the latter's service. Colonel Le Messurier is spoken of as the most likely man for the Calcutta appointment.

MR. BOSE'S WORK IN THE CENTRAL PROVINCES.—The retiring President of the Asiatic Society of Bengal, in referring to the economic features of the Geological Survey of India, said: The most interesting ore tract of manganese and iron near Jabalpur is again under examination by Mr. Bose. Several new features have been noted which may lead to a larger estimate of the distribution, and, perhaps, extent of the manganese ores than that put forth by the Messrs. Medlicott and Mallet in their original report.

BURRAKUR IRON WORKS.—Sir Charles Elliot with Colonels Hume, Brown and Neill, of the P. W. D., visited the Iron Works on the 6th instant. The Iron Works have now got on hand some very heavy orders for pig-iron, which will not only clear off all stocks, but find twelve months' work for the single furnace. Hence it has been decided to start the second furnace forthwith. Both the late Accountant and Cashier—to whom we referred in a previous issue—have been found guilty of the charge of embezzlement by the High Court, and sentenced each to five years' imprisonment.

THE JUBILEE BRIDGE.—At the ordinary meeting of the Institution of Civil Engineers on 24th January, the President, Mr. Bruce, being in the chair, a paper was read on "The Erection of the 'Jubilee' Bridge carrying the East Indian Railway over the River Hooghly, at Hooghly," by Sir Bradford Leslie, K.C.I.E. Much of the information given in the paper is comparatively stale to our readers, but there are some particulars not generally known furnished with reference to certain technical details, which cannot fail to prove alike useful and interesting to the profession in India.

THE COAL MINES OF TONQUIN.—A company has been formed to work the coal mines of Tonquin. The coalfields of Hon-Gay comprising about 15,000 hectares, including the lots known under the names of Hon-Gay, Ha-Tou, and Cam-Pha, have recently been conceded to it. Mining must commence within four months. The company has a capital of 5,000,000 francs. The production is estimated at 20,000 tons per month, and Chinese miners will be employed. Four steamers belonging to the company will sail regularly between Hai-Phong, Hon-Gay, and Hong Kong.

BOILER REGISTRY AND INSPECTION.—The Government at Home intend to create a council of 15 experts from the Civil Engineers and other similar bodies to determine what is necessary for the safety of the public, with reference to the Boiler Registry and Inspection Bill of 1887,

which will be introduced into Parliament in the ensuing Session. We adduce this information for the benefit of the Indian Executive, and at the same time point out the futility of stringent legislative enactments in the country when the agency employed by Government to give effect to such measures is questionable or defective.

CEMENT PLASTER.—The Madras Government would seem to have finally arrived at the conclusion that the use of cement is, on the whole, preferable to that of chunam in the repair of its buildings, for, since a trial was made some years back of coating with cement the inner wall of the ramparts, and St. Mary's Church in Fort St. George, its use has been gradually extended. Cement is also finding favor, not only with Government, but also with some of the mercantile firms, which have done wisely in preferring an increased initial outlay to that of being periodically subjected to the invasion of a gang of bricklayers with its attendant inconveniences.

THE SARDAR CANAL PROJECT.—There has been a happy find, the *Morning Post* says, in the Public Works Secretariat at Allahabad. It will be remembered that one of the most serious losses mentioned in connection with the fire in November last, was the entire correspondence and plans of the Sardar Canal project, the accumulation of many years' enquiry and labour. It appears now that some boxes containing a great part of these important documents had, for reasons unknown, been transferred to another room just before the fire broke out, and so have been saved to the great delight, no doubt, of Colonel Forbes and others intrusted with the undertaking.

MINERAL PROSPECTS IN COORG.—The examination recently made of auriferous quartz to be found in several localities in Coorg, has led to confident expectations being formed. A short time ago the services of the Government Mineralogist were applied for by the Chief Commissioner of Coorg, and the Madras Government assented to the Mineralogist paying a visit to that district. It would, however, now appear that there is no prospect of his services being available for the purpose. Under the circumstances no practical result, the Chief Commissioner is of opinion, can be expected, until the auriferous area has been surveyed by a trained mineralogist.

SEEBPORE ENGINEERING COLLEGE.—The Committee for the reorganization of this Institution are still at work; but their proceedings are enshrouded in mystery. Surely the public have a right to know something of the nature of the evidence on which the recommendations of the Committee are based. Our own view of the matter is that nothing could be lost while much might be gained by publicity or healthy discussion in such matters. Possibly before finally adopting any or all the proposals of the Committee, Government may submit them to public opinion; but the suggestions of the Committee would be all the more valuable if they combined such wide data with their own independent investigations.

STEAM BARGES FOR TRIBUTARY RIVERS.—The *I. P. G.* observes that the question as to the necessity of placing small steamers or steam barges on the tributary rivers of Assam, to serve as feeders to the main lines, is one that ere long will need serious attention. Several futile—not to say ludicrous—attempts have been made to solve this difficulty, but the result, so far, has been little short of exasperating to the general run of planters. When the steamer is urgently wanted

news arrives that she is hopelessly aground somewhere, and those who relied on her, have quite unexpectedly to rummage the villages for canoes and crews, too often failing to secure either, or having in most cases to pay exorbitant rates.

ITEMS FROM BURMA.—Mr. C. E. Thomas, Locomotive Superintendent, Burma State Railway, has obtained extension of furlough up to 1st January 1889. This is considered good for that Railway as the management of his department appears to have been lately distinguished for extravagance. Mr. W. H. Brand, Examiner of P. W. Accounts, has arrived in Burma and is to relieve Lieutenant Colonel H. R. Le M. Carey who goes on three months leave. Cast iron trolley wheels as made in the Insein workshop for the Burma State Railway have proved a failure as regards cost and durability and have been condemned, and 50 sets of proper cast steel ones have been ordered through the Secretary of State. These will cost less and prove more durable.

THE PROTECTION OF INVENTION AND DESIGNS' BILL.—Mr. Scoble, in presenting the report of the Select Committee on the Patents Bill, said it has been decided to make the charges of registration as light as possible. The fees would be, on filing an application, 10 rupees; and on filing a specification, 30 rupees. These payments would secure patent rights for four years. If the patentee wished to renew the protection for a further period, 50 rupees a year would have to be paid up to ten years; and after ten years' protection, 100 rupees a year. The Bill also provides for specifications being filed with local Governments. A person disputing patent rights is required to deposit the costs of the suit as a discouragement to frivolous and vexatious claims.

MUNICIPAL WORKS IN THE CENTRAL PROVINCES.—The Chief Commissioner has directed that the local Public Works Officers should assist the local bodies so as to prevent injudicious expenditure. He regrets to find from one report that this has been apparently construed into a direction to criticise adversely works after they are finished. This he considers disheartening to non-professional gentlemen who are giving much of their time and energy to public duty. What is intended is that the Public Works Officers shall regularly inspect and advise on works projected and works in progress, submitting their observations to the Deputy Commissioner, who will decide how far it is necessary or advisable to communicate these criticisms to the Municipal Committee.

NATIVE PUBLIC OPINION ON THE SONE IRRIGATION SYSTEM.—The *Indian Mirror* says that since these canals have been opened, they have certainly shewn no indications that the profit of 8·3 per cent., so confidently calculated upon, will be realised. It is only in one year since, that is, in 1878-79, that they have even paid their working expenses. General F. T. Haig, R.E., a late Chief Engineer of the Irrigation Department in Bengal, who was credited with considerable experience of Irrigation Works in the Madras Presidency, estimated that the Sone Canals might reasonably be expected to pay both the interest on the capital expended, and their working expenses, in 1887, and afterwards a profit over and above the 4½ per cent. interest on the capital outlay.

FIBRE AND FLAWS.—It is now eighteen years since the Government of India offered two prizes, one of £5,000, the other of £2,000, for machines which would decorticate the ramie or rhea fibre. By decortication is

implied the removal of the epidermis or outer cuticle or brown skin. The extraction of the woody pith has never presented an obstacle to success. It is more than strange that so long a period should have elapsed with such inducements, and that the mechanical skill and ingenuity of America and Europe should not have solved the problem of successful removal of this outer bark. There has been a large amount of capital invested in various machines whose inventors claim that they would decorticate, which on trial have proved entire failures.

EAST DECCAN COAL SUPPLY.—"I am now in a position," Mr. Pendlebury says, "to state that the Singareni Coal is an excellent Engine fuel. It is almost as easy to work and to handle as English, and better than any Indian Coal that I am aware of. Assuming that the cost at the pit's mouth does not exceed Rs. 3 per ton, the Singareni mines would be in a position to command the whole of the fuel trade for the G. I. P. Railway between Poona and Raichore, and a large share of the Hotgi and Gaday and Poona and Belgaum sections of the Southern Mahratta line. The prospects, therefore, of a considerable mineral traffic passing over nearly the whole length of the Railway are pretty well assured, and with easy gradients and cheap fuel a large revenue, even with moderate charges, ought to be derived."

WHY NOT PAY THEM BETTER?—In quoting our paragraph on the qualification of Sanitary Inspectors for India, *Invention* says that in view of the importance of the subject it might well ask "Why the Inspectors are not better paid?" Our answer is—"No money!" We may state that we had occasion some time back to point out to the Association of Municipal and Sanitary Engineers and Surveyors, London, that the cases of England and India are not analogous in such matters. We particularised towns in India with populations ranging from 20,000 to 80,000 souls where the Sanitary Inspectors or Municipal Overseers only draw salaries ranging from Rs. 20 to Rs. 80 a month for performing duties corresponding to those of Inspectors of Nuisances and Town Surveyors in England.

ITEMS FROM THE BENGAL COALFIELD.—The Honorable the Minister for Public Works recently visited the collieries and actually inspected "Borreah," the mine *par excellence* of the "Field." The mining interests in the district are getting very discontented about the slow progress of the Bengal-Nagpur Railway, especially about the promised mineral branch line. At all the pits large stocks of coal are on hand, but the coal trade is better, and more coal orders are in this week than the E. I. Railway can supply wagons for. The Boiler Inspector has now started to work on his *inspection tour*, commencing at Raneegunge. It is strange that the new *Boiler Act* does not apply to all the collieries. It does not touch Giridhi, Barragunda, Laikdee, or Khamerdhoobie—for some frivolous administrative reason?

DEFECTS AND THEIR CONSEQUENCE.—An unfortunate accident occurred on the G. I. P. Railway line last week, which is said to be due to a defect in the girder bridge fifteen miles from Bombay, between Dewa and Oomra. In crossing the bridge in question the foot-plates pass under the sill of the structure; and as the driver was standing on one of these plates he was hurled off. There is obviously a serious mistake in the construction of the bridge. Excellent as is the working of the G. I. P. line, it is surprising that a patent defect has been so long permit-

ted to continue. If the information on which we write be correct, all the girder bridges on the line should be examined, with the view of ascertaining whether any part of them, either because of their construction or by expansion through heat, projects too near the line.

THE GENERAL LE GRAND JACOB FOUNTAIN, BOMBAY.—This beautiful fountain was designed by Colonel S. S. Jacob, a Bombay officer and nephew of the late General Jacob, who at present holds the appointment of Executive Engineer to the Jeypore State, Rajputana. The marble was quarried in the neighbouring State; The workmen who chiselled the stone into its present beautiful form were all Rajputs (trained to this architectural work by Colonel S. S. Jacob during the construction of the magnificent Jeypore Albert Hall, for which building Colonel Jacob is also the architect); and finally the fountain, as now seen, was all constructed and put together loose in the Raj Garden at Jeypore; pulled down again after each piece had been numbered; and finally despatched to Bombay for its erection on the site it so well occupies.

THE LIGHTING OF THE COASTS OF CEYLON.—The Board of Trade have at length awakened to the necessity, and have determined to light up the whole south and south-western coasts of Ceylon. Engineers and English artificers came out recently from home, and are now hard at work in erecting two lighthouses, one at Dondra Head, the most southernmost point of the island, and the other on Barbaryn, a small island off Beruwela, about 4 miles north of Bentota. Both these new lights are to be first-class lights, having a radius of 15 to 18 miles, and that on Barbaryn will be erected on a tower 150 feet high. So that, when these two lights are erected, of which that on Dondra Head is by far the more important, the south and south-western coast of the island will be covered by a chain of lights right round from the Besses to Colombo.

LORD BRASSEY ON KURRACHEE HARBOUR.—In concluding our articles on the Kurrachee Harbour Works, we could not do better than quote Lord Brassey's opinion that it is "a port of immense importance, as the base for the military defence of the north-west frontier of India. By skilful engineering, the entrance to the port, the anchorage, and the wharfage, have been adapted to the requirements of steamships of large tonnage. A complete scheme for the defence of Kurrachee, both by batteries and torpedoes, has been sanctioned by the Indian Government and is in course of execution." The credit of the "skilful engineering" under which the improvements of the Port have been effected is mainly due to Mr. W. H. Price, M. I. C. E., who might surely look for some sort of recognition from the hands of Government in these days of plenty *in re* "Honors."

PUBLIC HEALTH IN POONA.—Regarding the sanitary (or insanitary) condition of Poona, a correspondent writes:—"The recent outbreak of cholera in the city of Poona has given an impetus to sanitary improvements, and various projects are afloat for the adoption of an efficient system of drainage. The present arrangements for drainage, admittedly defective, call very urgently for some early action on the part of the Municipality and Government to protect the interests of the people both in their health and their pockets. Deputy Surgeon-General T. Hewlett, C.I.E., Sanitary Commissioner for the Government of Bombay, has strongly advised the Government to take steps to compel the Municipality to carry out the drainage

scheme designed by Colonel Ducat, R.E., a few years ago which has received the approval of the highest sanitary authority in England, Mr. Rawlinson, but has been quietly shelved by the Municipality."

GOVERNMENT ARCHITECTS.—Madras can boast of having a "Consulting Architect" and Bombay an "Architectural Executive Engineer and Surveyor," while Bengal, with its "City of Palaces," has nothing of the sort. Mr. E. J. Martin, F.R.I.B.A., for many years held the office of "Architect to the Government of Bengal" till lately, when he reverted to executive work in his substantive appointment of Superintending Engineer. The gap occasioned first by his absence on leave, and next by his reversion, has never been properly filled, and the result is that the Government of Bengal in the P. W. D. have recourse to makeshift arrangements to meet the difficulty. With new public buildings springing up all over the province and many in contemplation in Calcutta, it is discreditable to those in authority to allow the present unsatisfactory state of affairs to continue, and the sooner they are remedied the better.

SEEBPORE ENGINEERING COLLEGE.—A Correspondent writes:—His Honour the Lieutenant-Governor of Bengal visited the College and Workshops yesterday (21st February) morning in company with Messrs Spring, Croft, and a few others. They were shown over the grounds by Mr. Downing, the other Professors and Executive Engineer keeping company. The object of this visit was, it is believed, with regard to the abolition of the Workshops. The results arrived at are unknown. As usual the apprentices and workmen were one and all made to do something. Mr. Spring was most minute in his enquiries. Sir Stuart Bayley was highly pleased with the drawings of the students—giving the laurel to the Apprentice Department. With regard to Mr. Toogood, nothing is settled yet. Should the Workshops be abolished he will most probably go on leave, otherwise he may stay back as Executive Engineer of the local Sub-division. The L. C. E. class contains only two students at present, as far as I am aware, but there may be more, who will appear in June for their examinations.

THE COMING RAILWAY.—The projectors of the Sind, Rajputana and Punjab line of railway having asked the Government of India to grant them a reconnaissance of the country proposed to be traversed, the Government consented, and Mr. Horace Bell, Chief Engineer of the Tirhoot State line, had been selected to carry out the operation. But at the last moment, it has been decided that, considering the nature of the ground to be gone over, the season is already too far advanced to begin. The reconnaissance will, however, probably be commenced at the close of the next rains. There is little or nothing to add at present about the project. It is, we hear, well supported in London. If made, it would command quite half the wheat export trade of Northern India and get the mails too. It seems likely that it may eventually absorb a portion of the Oude and Rohilkund line, but the main project now is for a direct line from Delhi through Bikanir and Jezsulmir to Kotri and so on across the Indus to Karachi. We calculate that the line would reduce the cost of wheat from Delhi to London by about 1s. 6d. per quarter, and it could certainly be made cheaply. But we know little or nothing of the country and whether the sand might not involve heavy cost in maintenance.

Current News.

THE decrease of the water-supply of Dalhousie has lately been the subject of consideration by Government.

MAJOR-GENERAL E. CRASTER, Royal Engineers, is permitted to retire from the service, from the 31st January 1888.

THE 32nd Pioneers are now busy bridging and improving the road between Siliguri and the Teesta river, in British territory.

LIEUTENANT RUSSELL, Royal Engineers, Military Works Department, is transferred from head-quarters to the Bombay Defence Division.

SIR LEOPOLD CAPPEL leaves by the mail of the 9th proximo, and Colonel Mallock will officiate as Director-General of the Telegraph Department.

DR. MURRAY THOMSON, long connected with Roorkee, Chemical Examiner, Allahabad, takes furlough next month, possibly not to return.

It is in contemplation to extend the Lahore Tramway to Mian Mir as soon as the necessary preliminaries can be arranged, and also to construct a line to Shalimar.

THE Secretary of State has intimated that the Government will next year resume control of the State lines at present worked by the East Indian Railway Company.

MR. HEBBERT who successfully carried out the water scheme for the city of Rawal Pindi, has been entrusted with the arrangements for carrying the supply into cantonments.

It is in contemplation to open another branch of the Bengal Central Railway between Singia and Khoolna on the Madhoo-mati, with an intermediate station between those two places.

THE 23rd Pioneers have been placed at the disposal of the Engineer-in-Chief of the Sind-Pishin section, North-Western Railway, for employment on the Khwaja section, now under construction.

THE question of connecting Bengal with Burma by a railway has been taken up by the Government of India, the Bengal Central Railway undertaking the survey eastwards from Jessore through Narail.

It is stated that the men employed at the Government Dockyard, Calcutta, have struck work since the 15th instant, owing to some of them having been fined one-and-a-half day's wages for being absent from work.

THERE was a conference at Hyderabad—Deccan, recently regarding the Nizam's Railway. Terms are to be offered to the Government of India for permission to construct the branch line to Raipur instead of to Chanda.

NEWS from Captain Triscott of the Jade Mines Expedition is to the effect that Sahan, on the Endawchoung, had been reached, and that the expedition expected to reach the jade mines on 6th February. No opposition had been encountered.

THE importation of kerosine oil into Calcutta is very brisk just now. There are 500,000 cases at Budge Budge, and owing to there being only accommodation for eight ships at a time a ninth ship which recently arrived is anchored in the river.

COLONEL F. D. M. BROWN, V. C., Superintending Engineer, Lucknow Circle, is about to take leave. As the appointment carries with it certain residence in the hills during the hot weather, it is somewhat coveted by the officers of the Department.

THE recent visit of His Highness the Maharaja of Kashmir to Mr. Lyall at Sialkot had reference to the proposed railway from that place to Jammu. Most of the material not forthcoming locally is on the way out from England, and work on the line will begin in a month or so.

THE Municipal Council of Vizianagram have engaged the services of Mr. J. A. Gauge, an engineer, to take level and surveys of the town, and to prepare estimates of the cost of improving the drainage and water-supply of Vizianagram, for the very moderate remuneration of Rs. 500.

It has been suggested by his Excellency Lord Reay that the Ghaut which has been surmounted by the new Railway shall be called the Braganza Ghaut. His Excellency the Governor-General of Goa has warmly approved of this felicitous and graceful suggestion, which will be acted upon.

THE India Office has directed that enquiries be made in this country as to the sources of supply of steatite or soapstone, with the view of seeing whether a sufficiently large quantity could be made available for export to England for the use of gas manufactures. At present it appears that all the steatite imported into England for the manufacture of gas goes from Germany.

SOME news has been received of the doings of the survey and exploration party that is at work beyond the Eastern Assam frontier. Captain Michell, writing from Camp Hamyom on the

23rd January, states that he had to cut a path for 4,500 yards through the jungle. The country is uninhabited. A road or railway is feasible, but the climate is the greatest obstacle, as the country is a vast fever jungle.

It has been decided that the Office of Examiner of State Railway Accounts, now at Bellary, be done away with; as all the State lines have been transferred to the South Indian Railway, the Bellary-Kistna line being handed over to the Southern Mahratta Railway. The accounts of these lines will be kept in the Office of the Examiner of Guaranteed Railway Accounts, Madras. These arrangements come into effect on the 1st April next.

THE following postings have been ordered in the Superior Accounts Branch:—Mr. J. S. Partridge, Examiner of Accounts, on being relieved of his duties on the Madras State Railways, is appointed Government Examiner of Accounts, Southern Mahratta Railway. Mr. F. Morrison, Government Examiner of Accounts, Southern Mahratta Railway, on being relieved, will take up the duties of Examiner of Guaranteed Railway Accounts, Madras.

AFTER the retirement of Colonel Sir R. Murdoch Smith, R.E., KCMG, the present Director-in-Chief of the Indo-European Telegraph Department, on the 15th instant, the administration of that system comes immediately under the Director-General of Telegraphs in India. From that date the title of the head of the amalgamated system will be "Director-General of Telegraphs" instead of, as before, Director-General of Telegraphs in India.

A PROPOSAL for the construction of a new Howrah bridge comes from home, and was considered by the Port Commission at their last meeting. The proposal is to replace the present floating bridge by a more permanent structure, and the outline plans have been prepared. Before long such a work will have to be undertaken unless we are to carry on with the pontoon bridge until a cyclonic wave or some other disaster sweeps it away.

MR. GUILFORD MOLESWORTH has reached Calcutta after a tour in Upper India. He proceeds shortly to Burmah to examine the progress made with the Tongoo-Mandalay Railway. This line has been so rapidly pushed on that the first engine is expected to be got through within two months from the present time. Regular traffic will, of course, not be possible until next cold weather, as the earthwork must be allowed to settle during the rains. The line will be one of the most quickly built on record in India.

A LITTLE time back some particulars were published of a scheme for working the Eastern and Northern Bengal Railways in combination with the Darjeeling line, with Mr. Franklin Prestage, the Manager of the last named concern, at the helm. The scheme has fallen through. A proposal for bringing one of the lines named, the Eastern Bengal, under the management of the Bengal Central Company, has been made from home; but this again appears to find no favour with the Government of India.

THE Government of India, in its Military Department have sanctioned a project of water-supply for the Rawalpindi cantonment. The proposal is to extend to cantonments the pure water-supply furnished to the city last year, as there is much more water than is required by the Municipal authorities. No time will be lost in carrying out the work, as the want of water in our largest garrison in India has long been felt. As land has been lately acquired which will about double the size of the cantonments, the question of a sufficient water-supply is one that could not longer be postponed.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

BHAGULPUR WATER-WORKS.

SIR,—In my letter regarding the Bhagulpore Water-works I stated that two schemes (*viz* the Central Jail and the Municipal) were in operation side by side without an attempt to combine the two for purposes of economy. It appears, however, that since a short time ago the Central Jail is being supplied from the Municipal system on payment of a monthly contribution of Rs. 200. This is a move in the right direction, and I am informed that the credit of it is due to the late Chairman of the Municipality. It now remains to be seen what use is made of the tanks and head-works belonging to the Central Jail scheme, which had cost a good lot of money.

While on this subject I think it worth mentioning that a water rate of 2 per cent is proposed to be levied from 1st April next. I cannot say how far this is true; but if it be true the authorities would be stretching the law in imposing a tax without giving the people any benefit from their water-works. Such taxation it need not be said, leads only to distrust in our Government, and should therefore be avoided as much as possible. It would, therefore, be a better plan to try to complete the works, if this be feasible, or to reduce their scope, if it be not so, and to honestly tax those who are to be directly benefitted.

BHAGULPORE; 16th February, 1888.

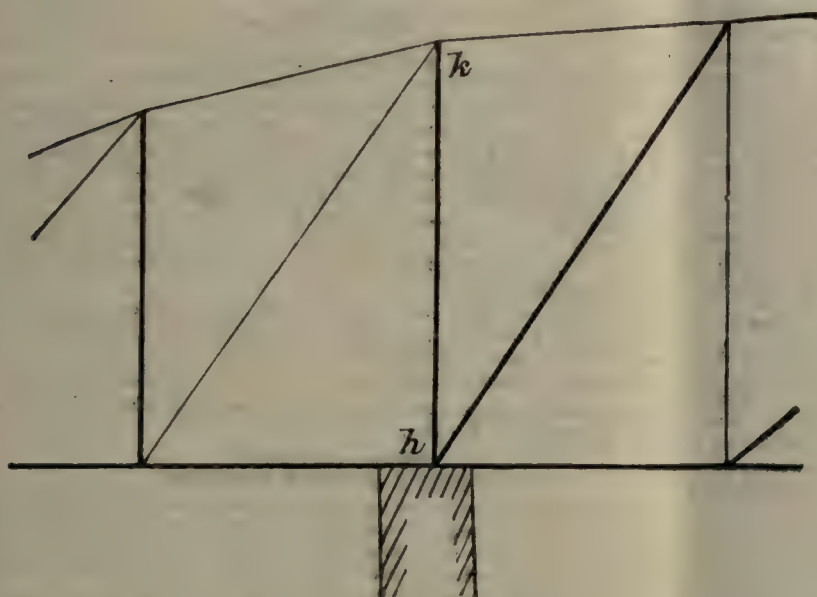
AN OBSERVER.

HOOGHLY BRIDGE CANTILEVER.

SIR,—Your issue of 3rd December has fallen in my way and I see in it a letter signed "F. E. R." on the above subject, which concludes with a sweeping attack on "the practice of Great George Street in general and the I. S. R. in particular." But for this I should hesitate to criticise the letter, because it is not too common to find Engineers who are engaged in hard practical work taking an active interest in theoretical enquiries, and such a disposition deserves all possible encouragement, whether or not we agree in all cases with the results of their efforts. When, however, partial and incorrect mathematical researches are made the basis of an attack on a whole profession, I think one is justly entitled to point out the imperfections of the argument as a reason for suspending judgment on conclusions so damaging.

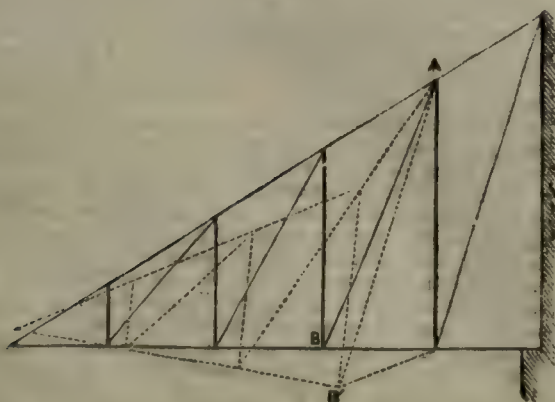
I propose to myself, therefore, the somewhat invidious task of pointing out how, while "F. E. R." busily plucks motes from the eyes of Great George Street, his own vision is not entirely unobstructed. He divides his investigation of the deformations of the cantilever into three parts, and the methods he applies in these three parts are mutually inconsistent and contradictory in the highest degree.

Fig. 1.



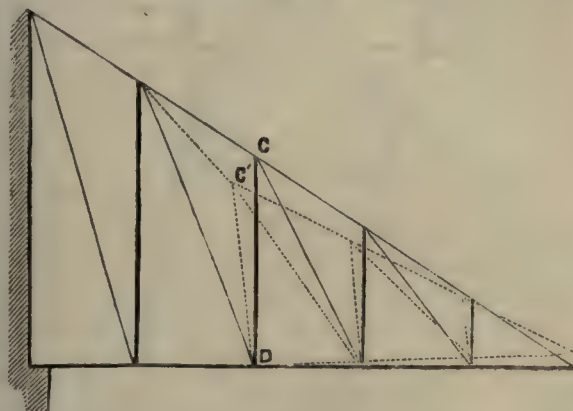
Firstly, he gives rules for calculating the deflections of the end of the cantilever due respectively to strain in a single member of the booms, ties and posts. I do not know where he got these rules from; if he invented them they do him great credit, as the subject has been too much passed over in books on bridge stresses. The only drawback is that they are all erroneous: the first is only true when both booms are horizontal: the second and third are so far wrong that they give results that may be either far less or far greater than the true ones, and results always positive when the

Fig. 2.



true deflection may be negative (i.e., upwards). In fig. 2 the extension of the tie AB (exaggerated of course) so that B moves to B', all other members of the cantilever remaining unchanged in length, throws the end of the cantilever upwards. The exaggeration in the diagram necessary to exhibit this effect only

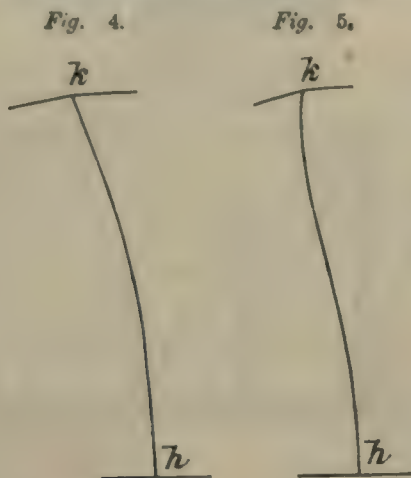
Fig. 3.



affects it in degree. Similarly in fig. 3, the compression of the post CD moves C to C' and elevates the end of the cantilever in like manner.

In his 'secondly' he expounds the method of determining the horizontal deflection of the middle part of the cantilever between the piers and here he makes an assumption absolutely at variance with the method of his 'firstly.' The rules he there gave were evidently based on the assumption of frictionless hinged joints, but now he assumes the bottom boom and the vertical post at *h* to be absolutely fixed in direction. If this were so, his former calculation would be all wrong (even if the rules were correct), for his rules are apparently meant to apply to the first panel as much as to any other, and therefore they assume a hinged joint at *h*; and this first panel is $\frac{1}{4}$ of the whole length from the pier, and has the most important influence on the deflection of any. Besides, the assumption of the fixture in direction is a most arbitrary one. The bottom boom appears to be continuous over the pier and must be of continuous though varying curvature. Also, as I understand, the base is a more or less yielding iron pier. The same inconsistency appears in his 'thirdly,' where he deals with the upward deflection of the unloaded end. Here he calls the bottom boom a beam fixed at one end. If the method of his firstly is good for anything, why does it not apply to one end of the cantilever as much as the other, in which case the unloaded end would simply rotate round its abutment without deformation.

Of course the real deformations of a triangulated bridge with rigid joints would be extremely difficult to calculate *a priori*; it is something between a beam of varying section and a hinged frame. To treat it as a hinged frame is probably the truest, as it is certainly the simplest way; but let one method be applied right through and not abandoned at pleasure for another method still more arbitrary. If, however, "F. E. R." had been consistent in this matter he would have lost the text for his tirade against Great George Street. If the deformations of the cantilever are plotted taking it as a continuous structure and not as three independent pieces, the fearful cross strain on the post *kh* does not appear. "F. E. R." is greatly concerned about this post. It "suffers from secondary strains" and appears to be in a very bad way, but the whole of his calculations regarding it, formidable as they may seem to the casual reader, are entirely vitiated by the false assumption that it is fixed in direction at one end and has a frictionless hinge at the other. I am sure "F. E. R." would not intentionally mislead any one, but it is a most extraordinary way of making out a case, to assume, that of two joints exactly alike, one is absolutely immovable and the other presents no resistance whatever to rotation of the post. He says "consider it as a cantilever fixed at *h* and loaded at *k*," and immediately proceeds to treat it as such without giving any reason for considering it so. This is an admirable plan which I have noted for future use. When I have a problem I cannot tackle—say the stresses in a stayed flat plate under pressure—I shall say: "Consider it as a jib-crane, or a steam-ship, or anything that comes handy. Seriously, when his whole attack is founded on a diagnosis of the sufferings of this post, it is something like a fraud on his readers to say "consider it as a cantilever," when they will all take him to mean that it really is one. "F. E. R." must ride on one horse or the other. If the joint *h* is rigid, then so is the joint *k*, and the post deflects as in fig. 5 and not as in fig. 4 (which is his charge against it.) The amount of its deflection as in fig. 5 depends on the general deformation of the bridge. If, on the other hand, the joints are to be taken hinged there is no distortion of the post at all. If the general deformation of the



cantilever with hinged joints be considered, it will be seen that the post kl is by no means the most suffering member as regards secondary strains. The boom at h changes its direction so much that the post kl will not vary its angle with the booms or its straightness much, while the resistance of the bottom boom to changing its direction will create much more serious secondary strains in that member. This brings me to the next of his fallacies. He leads us to suppose that the use of pin joints would abolish secondary strains altogether. But what about the compression boom? I do not gather that he proposes to go so far ahead of American practice, as to hinge the compression boom at every panel, and yet it may suffer from secondary strains as much as other members or more. Again, he says of his favourite post—"if it were hinged it would suffer no secondary strains." Has he got a patent for a frictionless pin then? The pins ordinarily used probably have a coefficient of friction of .15 to .2, and in a bridge of this size carrying a double line of railway a pin of 10 to 12 inches diameter would probably be necessary. If "F. E. R." will work out the bending moment from friction I think he will find it by no means inconsiderable.

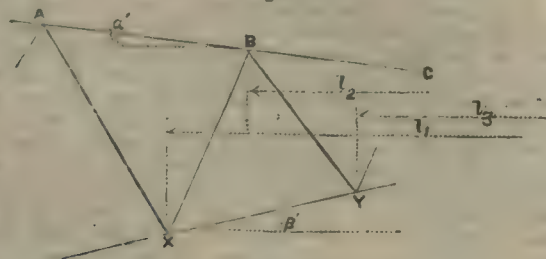
If "F. E. R." wants to get rid of secondary strains altogether he is quite right in supposing that none of the regular practitioners in Great George St. can help him; he will have to call in some of the Deputy Consulting Engineers your leading article describes to prescribe for him. I think "F. E. R." should also remember that England is by no means alone in adhering to rivetted bridges. Great George St. may be beneath contempt, but surely French and German Engineers are nothing if not scientific, and they adhere to the rigid system as much as we do. For my own part I should be disposed to agree with "F. E. R." if he went no further than to say that we might with advantage use pin connections in many cases where we now use rivets, but the points expressed or implied in his letter that I quarrel with are two. I do not think that the pin question is entirely, or even mainly, one of secondary strains, and again I dislike the violent dogmatism that brands as incapable or ignorant people that hold a different opinion on it from himself.

C. F. F.

ADDENDUM.

In place of the rules given by "F. E. R." for calculating the deflection of the end of a cantilever from the changes of length in its members separately I should give the following:—

Fig. 6.



Let $ABxy$ be a single panel, α° and β° the angles which the booms AB and xy respectively make with the horizontal; l_1 , l_2 , and l_3 the distances of the points x , B , and y from the vertical through the end of the cantilever; k_1 , k_2 , k_3 , and k_4 the elongation or compression per foot of length of the members AB , xy , Bx , and By respectively (k is for steel about .0007 for every ton of stress per square inch of gross section); δ_1 , δ_2 , δ_3 , and δ_4 the deflections at the end of the cantilever due to the strains respectively in AB , xy , Bx , and By . Then

$$\delta_1 = \frac{k_1 AB l_1}{Bx \sin \alpha} \quad \delta_2 = \frac{k_2 xy l_2}{By \sin \beta}$$

$$\delta_3 = k_3 \left\{ \frac{Bx \cos \alpha}{\sin \alpha Bx} - l_2 (\cot \beta xy - \cot \alpha Bx) \right\}$$

$$\delta_4 = k_4 \left\{ \frac{By \cos \beta}{\sin \beta yx} - l_3 (\cot \gamma BC - \cot \beta yx) \right\}$$

These expressions are here given in their most general form. In any particular case they will be much simplified, for generally α or $\beta = 0$, ABx , Bxy , yBC , or Byx is 90° , &c.

For myself I should generally prefer to ascertain the deflections by a graphic method, which is generally quicker and gives more information in a better form.

C. F. F.

GREAT GEORGE STREET—Westminster, S. W.
LONDON; 14th January 1888.

DEEP BORINGS.

SIR,—Now that the subject in regard to the advisability of sinking artesian wells in India is under consideration, it would be as well to compare the enormous depths that some have attained in Europe and America with those put down in this country. We have plenty of competent men in India who could show just as good results as the former, but it is the want of enterprise in India which is the bugbear that keeps us far behind other countries.

With the present efficient well sinking machinery at command borings which used to take years to complete are accomplished now in a very few months.

There is no doubt that the country is rich with underground aqueous sheets, and it is left to find out at what depths they are to be met with, and where; and this information can only be obtained by systematic borings.

AQUA PURA.

"A GOOD EXAMPLE."

SIR,—In the last of your "Notes and Comments" in your issue of the 21st January, you have fallen into an error, which I am sure you will be glad to have put right. The Railway you allude to is the Northern of Europe Railway, and is the work of English Engineers, many of whom are personally known to myself. The Company is an English Company, and was, I believe, entirely financed in England. In support of what I say I enclose some printed matter of recent date. I regret that I have destroyed several copies of the Company's prospectus, and also of Mr. Kalf's report alluded to in the same.

There is no doubt as to the wonderful richness of the ore obtainable at Gellivara, and the Company has in all probability a wonderful future before it.

BERUR; February 2, 1888.

A. M. I. C. E.

[We are obliged for the correction and satisfied with the information in support of it.—Ed., J. E.]

NATIVE ENGINE DRIVERS.

SIR,—The locomotive department of the Burma State Railway finds that native engine drivers, as compared with European, are content with less pay, burn less coal, are less troublesome, and more uniformly sober in their habits. Thereabout the Allahabad Railway organ suggests that the great bane of European and Eurasian workmen in India is drunkenness, and warns workmen that they must take heed to their ways and their liquor bills, or even in the matter of ordinary labor, natives of India will shunt them on to disused sidings in the scramble for employment that now prevails. It is true enough that the white man "likes his drop of good beer," or its spirituous equivalent—sometimes too well, rather than wisely. All energetic, conquering, colonizing nations always have.

One has only to refer to Vedic hymns to see what a large part liquor played in the lives of the Aryan masters of the ancient world. The Egyptians loved beer. Alexander the Great's veterans were the reverse of teetotal in habit. The heaven of the Norse Sea Kings was an illimitable supply of ale.

The amount of it triumphant German armies can stow away without winking astonishes and confounds seasoned English tipplers. The Russian conquerors of Central Asia flourish on vodka. Tommy Atkins cannot do without his canteen. Half the business done in the United States and Australia is done over nogging and drinks with extraordinary names, at hotel bars. In short, amongst modern nationalities, aptitude for strong drink seems to go hand in hand with vigorous energies on the way to success. Of course that is no excuse for drunkenness. It is a vice infinitely mischievous, which we have no slightest wish to defend, believing as we do, that it is one of England's greatest curses. This admission nevertheless cannot alter facts; does not disestablish the fact that peoples given to the use of alcohol prevail over peoples not so given. Let us have truth first: morality, or sentimentality, or anything else you like afterwards.

Native engine drivers, who are total abstainers, presumably are said to be cheaper material to work with, than European drivers. So they may be when everything connected with the running of the line they are employed upon, goes smoothly and in routine order. But when an emergency comes—and it has an ugly trick of coming when least expected—the native driver loses his head, emergency gives place to catastrophe, and over and above, life and limb sacrificed to his inaptitude, lakhs of rupees worth of plant and property get crumpled up too; and the Railway Company concerned finds as a consequence that

all the gilt has been taken off its gingerbread economy, and that there's the devil to pay besides. Then perhaps the ruling spirits of that Company discover too late that the cheapness they made so much of never was economy in any true and proper sense of that much prostituted word. People given to its promiscuous use, would do well to bear in mind the sensible old saw—Penny wise is pound foolish.

COMMON-SENSE.

Literary Notices.

HANDBOOK OF SPECIFICATIONS, ETC., FOR THE MEERUT, AGRA, MORAR AND BAREILLY DIVISIONS, MILITARY WORKS. Roorkee : 1877.

IN its own very limited range this is a useful book of reference for the Engineer-Architect, and although there is nothing new in it whatever, (it sticks religiously to the old wooden roofs) still, if any one does want to design a wooden roof of any kind, this volume gives all the information required, in a rather clumsy way it may be added. The first 45 pages which by some unaccountable freak are printed on one side only, are devoted to specifications of different kinds of work. We notice a good tip under the head "Terraced Roofs." The concrete is to be thoroughly rammed until the lime flushes to the surface, and then the surface is rendered smooth and polished with the trowel. This system is undoubtedly preferable to the one ordinarily employed, viz., of putting a separate layer of plaster on top of the concrete. On one point, however, we beg to differ from the author. He specifies 6 inches of concrete laid over the flagging to be beaten down to a final thickness of 5 inches. We are strongly of opinion that this depth is insufficient. What with variations of temperature, alternate dryness and moisture, there frequently must occur a movement of some kind in the framework of a roof, and unless the terracing be very thick, it will be certain to crack up eventually. In old native buildings, or flat-roofed houses, engineered by the native mistri free from the trammels of P. W. specifications, we find, that never less than 9 inches, and often a solid foot or more of terracing is used. These men understand their business, and there are numerous examples of old flat roofs, which have stood for 40 or 50 years without leaking, even when the wood work below has quite rotted. One very excellent plan formerly adopted by native mistris is the following ; Directly above the flagging 3 or 4 inches of mud is laid, and on top of this layer the *pucca* terracing. The mud acts as a non-conductor of heat, and likewise relieves the less elastic concrete from direct contact with the roof frame. In our opinion, the minimum depth of consolidated terracing should be 8 inches, put down in 2 layers. The chapter on corrugated iron roofing is too meagre. We might have been given examples of untrussed arched corrugated roofs, which can be used up to 30 feet span with safety.

The entire absence of notice of anything out of the ordinary P. W. routine practise is painful, and it is a serious blot on all similar Government publications. A bureaucratic red tap semi-demi Military Department like the Public Works cannot it appears shake itself free from old traditions ; it is quite content to plod along in the same groove.

The next 70 pages are devoted to calculations, the formulæ being all given in one table, easy of reference, together with tables of strength, weight of materials, constants for Indian timber, etc. We consider that too much space has been allotted to the calculations ; which after all are a very simple matter. They are given in great detail, and are all worked out by logarithms, displaying a vast array of figures. Most of this is quite unnecessary. No practical man would go in for such refinement, as taking W, the weight per square, to 3 places of decimals. Nearly all the sums could be worked out in half the time by ordinary arithmetical process with the assistance of tables of squares and of natural lines, and the absurdity of adding the log of 5 to the log of 2, which we have noticed in one case, would be avoided. Any Indian Engineering College student would be ashamed to be doing calculations in this round about ponderous way.

Graphic methods of calculations are conspicuous by their absence. But graphic statics were unknown to the P. W. D. of those days. We must not forget that this book was published in '77.

On one page we note a table of the strains on tie rods in arched roofs. It is quite useless, and it is evident that the author had no experience in this matter. For $7\frac{1}{2}$ feet span he gives tie-rods 1 foot apart !! A thick wire would almost have sufficient sectional area at this spacing.

The rest of the volume is mainly taken up with plates, which are extremely well executed and are very useful as far as they go. All sorts of details are given such as how to fix a bottle head in a wall for a punkah rope and other minutiae which savour of the barracks. A table of rates is also given.

The Military Works Department is known to pay enormous rates for their work as a glance at this will show. We have not space and time to discuss this point now, though we may on a future occasion ventilate our opinions on the reasons which account for high rates in this Department and in a lesser degree in the Provincial Public Works.

New Books and Reprints.

ART AND ARCHITECTURE.

- ARMSTRONG (Walter) Scottish Painters : A Critical Study. With many Illusts. Folio, pp. 90 Seeley. 21/; large paper, .. 84/
BEALE S. Sophie) The Amateur's Guide to Architecture. With numerous Illusts. Cr. 8vo. Virtue and Co. ... 3/6
CHURCH (A. H.) Colour : An Elementary Manual for Students. New and enlarged ed., with 6 Coloured Plates. Post 8vo. pp. 188. Cassell. ... 3/6
DAY (Lewis F.) The Planning of Ornament. Illust. (Text-Books of Ornamental Design.) Post 8vo, pp. 58 Batsford ... 3/6
DENYSE : A Sketch in Neutral Tints taken from the Portfolio of a Rambler. Edited by Helene E. A. Gingold. Frontispiece by "Lib." Post 8vo. pp. 278. Remington. ... 7/6
GEDDES (Patrick) Every Man his own Art Critic at the Manchester Exhibition, 1887. Cr. 8vo, sd., pp. 32. John Heywood ... 6d.
LEE (Arthur) Marble and Marble Workers : A Handbook for Architects, Artists, Masons and Students. 12mo, pp. 154. Crosby Lockwood 2/
MACKINTOSH (A. H.) Wren's City Churches : The Substance of a Lecture given at the Rev. S. Brooke's College at a Time when Wren's London Churches were Threatened with Destruction. Its Object being to Arouse Public Attention, and Lead to a Better Appreciation of their Merits. With full-page Steel Engraving. Med. 8vo. G. Allen (Sunnyside, Orpington) ... 5/
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CRAIG (J. E.) Azimuth : A Treatise, with a Study on the Astronomical Triangle, and of the Effect of Errors in the Data. Illust. by Loc of Maximum and Minimum Errors. 4to New York ... 18/
PONTO (Mungo) Earthquakes. Their History, Phenomena and Probable Causes. New and revised ed., with an Account of Recent Earthquakes, by the Author of "Chips from Earth's Crust." Post 8vo, pp. 218. Nelsons ... 2/6

ANNOUNCEMENTS.

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- HARTLEY (W. N.) A Course of Quantitative Analysis for Students. Post 8vo, pp. 230. Macmillan. ... 5/
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Elementary Inorganic Chemistry. Alternative Course. By W. Furneaux.

General Articles.

KARACHI HARBOUR WORKS.

(Concluded from page 93.)

SPECIFICATION FOR SHIP WHARF EXTENSION.

THE work to be carried out is the supplying and delivering on boardship in one or more of the ports named in the form of tender the whole of the ironwork of the substructure of a screw pile ship wharf, 1,200ft. long, consisting of one row of seventy-five wrought iron piles, 6in. diameter and 52ft. 3in. long, and two rows each of seventy-five piles, 5in. diameter, 47ft. 9in., and 35ft. 9in. long, respectively, from the heads of the piles to the points of the screws. They are to be braced together horizontally and diagonally in a longitudinal and transverse direction, in the manner shewn in the drawings. The row of wooden piles will be provided at Karachi, but the cast iron pile caps for them are included in this contract.

Screw Piles.

1. The piles, bearings, tie-rods, clips, straps, bolts and nuts, pins, &c., are to be of wrought iron, the screws and pile caps of cast iron.

2. The wrought iron is to be of quality satisfactory to the Engineer, and is to be capable of sustaining a tensile strain of 20 tons to the square inch under a blow struck with a heavy hammer.

3. The clips, straps, bolts and nuts, and pins to be of the best approved scrap iron. The clips to be carefully bent to the form shewn in the drawings, and the parts bent are in no case to be reduced to a thickness less than they had previous to bending. The whole to be approved by the Engineer.

4. The cast iron is to be of the toughest description, cast clear, sharp, and true to form, and free from air and sand holes and other defects. Specimen bars of this iron, 2in. by 1in. and 3ft. 6in. long, are to be cast from time to time as may be directed by the Engineer, and are to be tested as follows:—They are to be laid on edge with a clear bearing of 3ft., and if they break with a load of less than 28 cwt. at the centre, all the castings made from such iron are to be rejected.

5. All the fitting and other workmanship throughout is to be done in the best and soundest manner, and such fitting, drilling, &c., as the Engineer may consider most convenient to be done at the time of erection is to be left—see particulars under their respective heads.

6. The pile shafts are to be planished, and the remainder of the wrought ironwork, before it is exposed to corrosion, is to be coated with boiled linseed oil, applied hot; and as soon as the wrought and cast ironwork has been inspected and approved at the factory the whole is to be scraped, cleaned, and covered with two good coats of best anti-oxide oil paint.

7. A portion of the wharf, consisting of three piles in each row, is to be erected complete on the contractor's premises. The parts so erected are to be made from the same pattern, templates, or models, as the corresponding parts of other portions.

8. The quality of materials, workmanship, and preparation for shipment are throughout to be subject to the inspection and approval of the Engineer in England appointed or authorised by the Secretary of State in Council, whose interpretation is also to be taken and accepted on any discrepancy or doubt found or arising in the plans, specifications, or measurements.

9. The figured dimensions on the plans are to be adopted in preference to scale measurement.

10. The shafts of the piles are to be 51½ft., 47ft., and 35ft. long in the three rows, respectively. They are to be shod with cast iron screws and crowned with cast iron caps as shewn on the drawings.

11. The heads and feet of the pile shafts are to have two of their sides flattened by ¼in. each; the heads for a distance of 8in. to receive the screwing keys, and the feet for 12in. to fit into the screws.

12. The screws are to be of the forms shewn. The dia-

eters of the flanges are to be the same for the two sizes of pile, but the spindles are to be larger for the 6in. than for the 5in. piles, and the sockets are to be cast to fit the piles exactly.

13. The flange is to be saw edged and to make 1½ turns on the spindle, and 1 turn and 3in. at the circumference with a 6in. pitch. The spindle is to have an auger point. A wrought iron ring ¼in. thick is to be shrunk on the neck of the screw. A hole is to be drilled through the spindle and the foot of the pile to receive a pin 1in. diameter, which is to be provided and left to be rivetted. The ends of the hole are to be enlarged to a conical form and the pin to be formed with a corresponding conical head. Each screw is to be fitted on its own pile at the factory and numbered accordingly.

14. The caps for the pile heads are shewn in the engraving. Those on the face piles are to be fitted with wrought iron clips to serve as lugs for the connection of the diagonal bracings. Those for the two inner rows of iron piles to have lugs cast on them, and those for all the timber piles to be of cast iron without lugs.

15. The caps are each to have four 1¼in. bolt holes in the table for fastening down the main girders. The holes for all these bolts are to be drilled at the factory exactly to the measurements shewn.

16. Three pins, 1¼in. in diameter, and of lengths slightly in excess of the outside diameters of the caps, are to be provided for each pile head to secure the same to the cap, but the holes to receive them are not to be drilled either in the cap or the pile head.

17. For convenience of stowage, both the caps and the screws are, after being fitted, to be detached from the pile shaft and shipped separately.

18. The piles in the face row are to be connected longitudinally by two lines of horizontal braces, the centres of which are to be placed at 11ft. 8½in. and 24ft. 5in., respectively, below the heads of the pile, the former consisting of one channel iron, 6in. by 2½in. by ¼in., and the latter of two similar channel irons, which are to be connected at the centre of their length by a 1in. bolt passing through a cast iron circular distance piece 2in. thick. The same piles are also to be connected by two diagonal braces between each pair of piles carried from the head of one pile to the level of the lower horizontal brace on the adjoining pile, each consisting of an angle iron 6in. by 4in. by ½in. The two are to be bolted together, and to the horizontal braces at the crossing with three ¼in. bolts passing through cast iron distance pieces where necessary.

19. The piles in the second row are to be connected by one line of horizontal bracing at the level of 11ft. 8½in. below the heads of the piles, consisting of one channel iron 6in. by 2½in. by ¼in., and by two diagonal braces between each pair of piles carried from the head of one pile to the level of the horizontal bracing on the adjoining pile, each consisting of an angle iron 6in. by 4in. by ½in., and bolted together at the crossing with one ¼in. bolt.

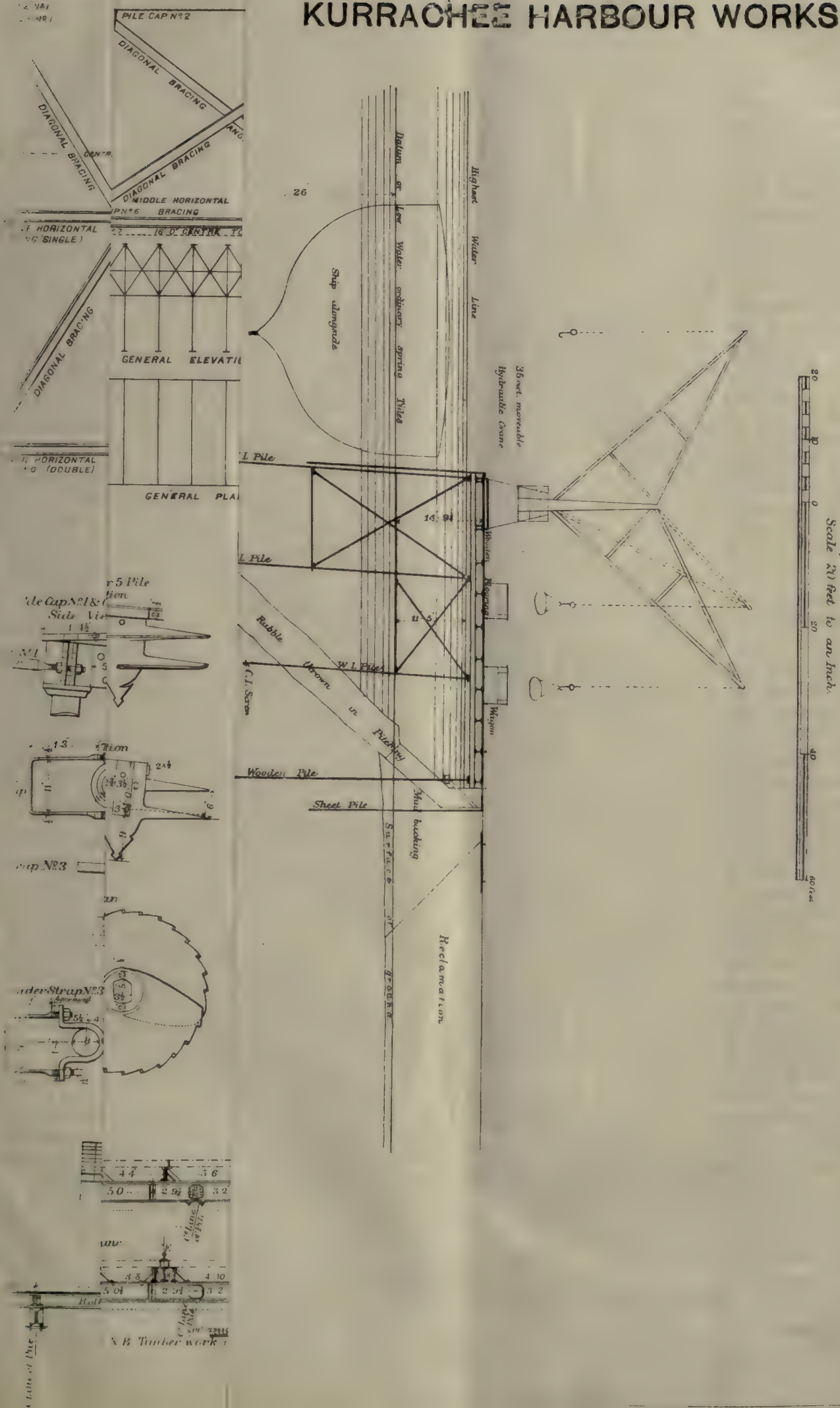
20. The piles in the third row are to have no longitudinal horizontal bracing.

21. The piles of the second row are to be connected to the piles of the face row transversely by two horizontal braces, at the same level as the longitudinal horizontal braces; the upper one consisting of one and the lower of two channel irons 6in. by 2½in. by ¼in.; also by two diagonal braces from the heads of the piles of one row to the level of the lower horizontal braces of the corresponding piles of the other row, each consisting of a single angle iron 6in. by 4in. by ½in., which are to be connected together at the crossing in the same manner as in the case of the longitudinal bracing.

22. The piles of the third row are to be connected to the piles of the second row by one horizontal brace at the same level as the upper braces above described, consisting of one channel iron, 6in. by 2½in. by ¼in., and by two diagonal braces from the heads to the level of the horizontal

KURRACHEE HARBOUR WORKS

Cross Section of ENSKINE WHARF as partly constructed and further under construction at Keamari



braces, consisting of angle irons, 6in. by 4in. by $\frac{1}{2}$ in., connected together at the crossing by one 1in. bolt.

23. The whole of the braces are to be cut to the lengths shewn on the drawing; with square or oblique end, as may be required; and the holes for the bolts are to be drilled in the channel iron or horizontal brace; but in the angle iron or diagonal braces, except in those required for the two bays to be erected in England, the holes are to be drilled at one end only, those at the other end being left to be drilled at Karachi.

24. The clips for the attachment of the braces and the fender straps, to be hereafter described, to the piles, are to be of nine different patterns, as shewn. They are so arranged that any one of them can be removed or replaced for purposes of renewal or repair after the completion of the structure, and this condition must be carefully preserved. The holes for the $\frac{1}{4}$ in. bolts by which the braces and fender straps are to be attached are to be drilled with accuracy in the positions shewn, and each clip is to be sent out with its bolt in place, together with such iron packing pieces as are required, as shewn on the drawings. Spare bolts are to be provided, as per schedule attached.

25. Wrought iron fender straps of the form shewn are to be provided for all the face piles. The upper and lower straps upon each pile are to consist of bars of flat iron 2in. by $\frac{1}{2}$ in., bent as shewn, with a round bar $\frac{1}{4}$ in. diameter welded on to each end, the ends of which are to be screwed and provided with nuts to enable them to be secured to and tighten the clip. The middle strap is to consist of a bar 3in. by $\frac{1}{2}$ in., bent as shewn, and with a hole at each end, and a bolt $\frac{1}{4}$ in. diameter passing through each end hole, and securing it to the clip in the manner as in the case of the upper strap with two nuts.

26. All bolts, straps, and other small articles are to be packed for shipment either in strong wooden cases, or securely bound together in bundles of convenient size. The smaller bolts to be in strong bags inside the cases.

27. All the articles to be marked K. H. B. and numbered consecutively in paint, and a shipping specification descriptive of the several articles with the outside dimensions and weight of each to be furnished at the time of shipment.

Conditions same as the Indian State Railways.

SPECIFICATIONS FOR SHIP WHARF EXTENSION.

Girders and Joists.

The work carried out under this contract was the supplying and delivery on boardship in one of the ports named in the form of tender, 225 main girders, and 918 floor girders, with flitch plates, joint plates, stays, bolts, rivets, and other fastenings, as described below, to form the superstructure of a screw pile wharf 1,200ft. long, of which 624ft. is straight, and 576ft. is on a curve of 4,800ft. radius. The following description is from the specification:—The girders are to be rolled joists of English manufacture, and to be of good and tough iron of fibrous structure, or of steel of approved quality, and are to be subjected to the following tests:—One in every twenty of each sort to be selected by the Engineer is to be supported at both ends over an opening of 15ft. 2in., and loaded in the middle, the joists of the main girders with a weight of 20 tons, and the floor girders with a weight of 12 tons, on the removal of which there shall be no permanent deflection. One of the main girders and four of the floor girders from every lot offered for shipment shall then be further weighted until they give way by crippling or fracture, and if in doing so they break or cripple with a less weight than 30 tons or 18 tons, respectively, or if in doing so they give evidence of any unsoundness or other imperfection, the whole quantity offered may be rejected, the contractor to replace the broken or crippled girders. The wrought iron in flitch plates, stays, and washer plates to be of quality satisfactory to the Engineer, of good fibrous structure, and capable of sustaining a tensile strain of 20 tons on the square inch under a blow struck by a heavy hammer. The straps, bolts and nuts, and pins to be of the best approved scrap iron, the rivets of

the best rivet iron. All the fitting and other workmanship throughout is to be done in the best and soundest manner. The main girders will be placed transversely to the wharf, and each line of three girders will rest on four pile caps 16ft. apart from centre to centre. They are to be in lengths of 16ft. $6\frac{1}{2}$ in.; 16ft.; and 17ft. $8\frac{1}{2}$ in., the ends at the face and back of the wharf are to be bolted down to the pile caps each by $\frac{1}{4}$ in. bolts, as shewn, and the ends which meet over the intermediate piles are to be bolted to the caps each by two similar bolts. Templates of the pile caps will be provided. The girders are to be of the section shewn on the drawing, and are to consist of a rolled joist 14in. deep, 6in. wide at top and bottom, and weighing not less than 60lb. to the lineal foot, if of iron, and of a weight giving equal strength if of steel, strengthened with flitch plates 10in. by $\frac{3}{4}$ in. rivetted on the top and bottom by $\frac{3}{4}$ in. rivets at distances of 4in. The rivet heads on the under sides are to be counter-sunk where the girders rest on the pile caps, and on the upper sides where the floor girders rest on the main girders, and for a distance of 4ft. from the inner ends of the outer rows of the girders. There are also to be ribs or stiffeners of angle iron $4\frac{1}{2}$ in. by $\frac{1}{2}$ in. accurately cut to fit the form of the girder, rivetted on each side at three points on each girder, as shewn on the drawing. The girders are to be fished at the junctions by plates 12in. by 11in. by $\frac{1}{2}$ in. prepared to be rivetted one on either side of the ribs. These plates are to be cut and the rivet holes made in them and in the girders to one uniform pattern, so that they will be interchangeable for any position of the same form of girder. The floor girders are to be also of rolled beams, but without flitch plates. They are to be 12in. deep, 5in. wide at top and bottom, and to weigh not less than 42lb. to the lineal foot, if of iron, or of a weight giving equal strength if of steel. There are to be twelve lines in the width of the wharf, except for six bays, as shewn on the drawing, where there are fifteen, and the girders are to be cut in different lengths for each line for the 576ft. which are on a curve, the line nearest the face being 16ft. and that nearest the back 15ft. 10in., the others being in proportion according to their distances from the face of the wharf. For the straight part they are all to be 16ft. The girders are to be prepared to be bolted down to the upper flitch plates of the main girders by two $\frac{3}{4}$ in. bolts in each end, with heads of a form to suit the flange of the girder. The joints are to be fished, each with two plates $9\frac{1}{2}$ in. by 6in. by $\frac{1}{2}$ in. and eight $\frac{3}{4}$ in. rivets. The floor girders are further to be stiffened at each crossing of the main girders by an angle iron stay $2\frac{1}{2}$ in. by $2\frac{1}{2}$ in. by $\frac{3}{4}$ in., bent at the ends, as shewn on the drawing, and secured to the web of the floor girders, and the upper flitch plate and flange of the main girder by a $\frac{3}{4}$ in. bolt in each. The bolts are to be fitted with tapered washers to suit the slope of the under side of the flange. Five hundred wrought iron plates, 9in. by 4in. by $\frac{3}{4}$ in., bent to the form shewn on the drawing—enlarged view at D—and provided with two holes for the bolts which will pass through the planking to secure the inner rail of the 35 cwt. crane line, are to be provided. The ends of the plates are to be bent to suit the under sides of the flanges of the floor girders, and the central part bent upwards so as to be $\frac{1}{4}$ in. below the top surface of the girders. The holes are to be $\frac{3}{4}$ in. diameter, and placed at such distance apart as may be directed to suit the width of the foot of the rail. Four hundred and fifty plates, 14in. long, formed of a channel iron, 5in. by 2in. by $\frac{1}{2}$ in., and bent as shewn on the enlarged view at C, are to be provided for the outlet rail of the crane line except for the 96ft., on which there are to be three lines of girders, and for this portion 100 washers, $6\frac{1}{2}$ in. by 4in. by $\frac{3}{4}$ in. of the form shewn on the enlarged view at E, are to be provided. Proper holes in each case to be punched to receive the ends of the holding down bolts. Eight hundred and seventy wrought iron plates, $8\frac{1}{2}$ in. by 3in. by $\frac{3}{4}$ in. are to be provided to place under the rails of the crane lines. They are to have holes in them to receive the hook bolts on either side of the rail. One hundred similar plates, but 8in. wide, and with four holes in

each, are also to be provided to be placed under the joints of the crane line rails. Two thousand three hundred hook bolts for securing the rails of the crane lines, as shewn on the drawing, are to be provided. The heads are to be made to fit the flanges of the rail, a template of which will be supplied.

The following bolts are to be provided for securing the timber work, as shewn on the enlarged view at C, viz., eighty strap bolts with nut and washer at one end to pass through wall, planking and curb to the side of the fender; 250 bolts $\frac{3}{4}$ in. diameter, 12 $\frac{1}{2}$ in. between head and nut, with washers for bolting the above to the fender; eighty bolts each with two nuts on one end and a washer to secure wall to floor girders through head of angle iron stay horizontally; and 240 bolts 1 in. diameter, and 1 ft. 11 in. between head and nut, each with two washers to pass through curb, planking, and wall vertically.

The portion of the wharf shewn dark, on the general plan given herewith, is to be erected complete, with stays, joint plates, &c., on the contractor's premises. The parts so erected are to be made from the same patterns, template, or models, as the corresponding parts of other portions. Before it is exposed to corrosion, the whole of the ironwork is to be coated with boiled linseed oil, applied hot, and as soon as it shall have been inspected and approved at the factory, all the parts, with the exception of the bolts and rivets, are to be scraped clean, and covered with two coats of best anti-oxide oil paint.

"REFORM IN HIGHWAY BRIDGE BUILDING."

A REVIEW.

THERE is a general impression that American bridges are rather risky structures, and it appears to be more than justified, by the exposure of the too common system of building bridges, which the little work* under notice is intended to counteract by supplying information and specifications which can be understood by any Board.

The better class of American bridge is more scientifically designed and constructed than the average English bridge, and it is clearly explained in this book how it is, that the country which produces these structures, can yet boast an average of forty bridge failures in a year, and these not old worn out wooden bridges, but new iron ones.

The first part of the book is taken up with suggestions which have no direct interest for the English Engineer, as the conditions which have led to the state of affairs they are intended to remedy do not exist either in England or India.

But the "Specifications" proper, which form the second half of the book, will be a useful addition to the library of every Engineer, or still better, the larger work† of which this is an abstract for the general public. The latter contains a mass of information and tables on every point of detail in bridge design, that can be found in no book published in England, to such detail in fact does it run, that it would be possible for an enterprising Collector without consulting an Engineer to order a bridge that would not be dangerous.

We have only noticed one oversight in the "Specifications," where at page 29 the author says *** "the pinholes in the top chords must be bored just far enough below the centre of gravity of the section, to make the upward bending moment induced thereby when the strut is under its greatest stress, balance the moment of the weight of a panel length of the chord."***. This device is certainly applicable to a bottom chord of links and might be worth using with long panels and heavy bars which should of course be figured for the stresses induced by their own weight. But it cannot be used in the top chord, for that being continuous, the moments of flexure from its own weight and intermediate loads, are reversed at the panel points, and placing the pins below the centre of gravity would increase the stresses at these points. The same error exists in a

useful little book on the *Strength of Bridge Members* by S. W. Robinson, No. 60 of Van Nostand's Science Series.

Similarly at page 32, the author says "when joists rest directly on top or bottom chords, the latter will be considered as beams * * * fixed at the ends." Here of course it is only the top chord which can be so considered.

The author gives 300 lbs. per square inch as the limiting pressure on bed-plates, but this is so high, that we should be disposed to think it a misprint, were it not given both in words and figures. Surely 200 lbs. is enough, and this is the amount given in the larger work.

The author prints in capitals: "*Rivets must not be used in direct tension.*" Evidently his experience tallies with ours, which is, that this most objectionable detail is used even in important parts by people who should know better. Nothing is more common than to see a bracket introduced to afford the required rivet area, with one wing pulling on the heads of the rivets. If this cannot be avoided, the drawing should be conspicuously marked for bolts, for at least we do know what is the strength of a nut, provided always it has been properly screwed up, and does not start with an initial stress of nearly as much as it can carry, due to the efforts of a workman with more zeal than discretion and a big spanner.

Another point not always attended to, which is noticed in these "Specifications" is, that all bed-plates and rollers must provide against lateral sliding. We believe that not long ago a span of 100' or 150' somewhere in Southern India was blown off the piers from want of attention to this detail.

Altogether, though the object of the work is to supply Local Boards with information as to what they should get in a bridge, and what points must be avoided, the "Specifications" are so full and so practical that they will form a useful book of reference for any Engineer.

We trust that the author will be inclined some day to publish his work on "*Railroad Bridges for Japan*," which has been printed, but not published, by the Tokio University, in which he was sometime Professor of Civil Engineering. A good deal of the matter is of course common to the book on Highway Bridges, but there is quite enough of independent matter to make the book a most useful acquisition to a branch of Engineering literature which, in England at least, is very poorly represented.

F. E. R.

* General Specifications for Highway Bridges of Iron and Steel. By J. A. L. Waddell. Kansas City: Macdonald and Spencer. 1887.

† The Designing of Ordinary Iron Highway Bridges. By J. A. L. Waddell. New York: Wiley and Sons. Second Edition. 1886.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

XXVI.

Asphalting $\frac{1}{2}$ " thick.

Items per 100 s. ft.		No. or Quantity.	Rate.	Amount.	Total.
(1)			(3)	(4)	(5)
Labor.—					
Plasterer	No. ...	2:33			
Coolies	" ...	4:20			
Do	" ...	'85			
Cart for carrying boiler, fuel, asphalt, &c., No. ...		1			
Sundries, frames, &c.		.....		
Materials.—					
Asphalte	lbs. ...	427	Variable.	Do.	Do.
Bitumen	" ...	18'8			
Fine river sand	c. ft. ...	2 6			
Firewood	md. ...	3 8			
Sweet oil	lb. ...	'59			
Sundries	.....			
Petty Establishment		.....		

THE MANUFACTURE OF IRON AND STEEL IN INDIA.

I.

THE manufacture of iron and steel appears to have been known in India much earlier than in Europe.

Fragments of old steel arms, tools and other iron and steel articles of very ancient origin, as well as extended iron slag heaps in such parts of India, where neither history nor tradition can remember that iron has ever been manufactured, leads to the conclusion that the iron and steel industry of India was in previous times of considerable importance.

The Kutub pillar near Delhi is a prominent memorial of old Indian blacksmiths' art, and it would rather embarrass our modern European iron masters, notwithstanding all their advanced appliances, if they had to produce such a piece of art as the wrought iron column of Kutub in the way as it was produced some 1,600 years ago by Indian blacksmiths with their primitive machinery.

This column has a total height of 23 feet 6 inches with a diameter of $16\frac{1}{2}$ inches at base and 12 inches below the capital, the latter being $3\frac{1}{2}$ feet high. Below the surface it expands to a bulbous form of 2 feet 4 inches in diameter and rests on a gridiron of iron bars fastened with lead into the stone pavement.

This pillar has evidently been formed by gradually welding small pieces of iron together, but notwithstanding this rather difficult process, it shows no trace of a weld seam and no sign of rust although exposed to the atmosphere for more than 1,600 years.

From the inscription which this column bears, Mr. Fergusson believes, that the column owes its existence to the fifth century; Dr. Hoernle thinks it is still older.

It is however strange that in the Punjab, where this noble specimen of Indian blacksmiths' art was found, native iron industry is the most backward, compared with other parts of India, as the Punjab depends for its supplies of even the simplest native iron tools on the neighbouring provinces.

Wrought iron cannons of extraordinary length have been made in Assam without doubt, in a similar skilled way and difficult manner, as the Kutub pillar at Delhi.

Balasore in Oriss, supplied up to the commencement of this century, nearly all the vessels, passing the coast close by, with ship anchors of excellent quality.

First however in importance in the history of Indian iron and steel industry is the fact that cast steel was made in India long before the manufacture of this most important metal of modern demand was commenced in Europe and that the excellent quality of Indian cast steel ("Wootz") has not been reached in Europe as yet.

It is also hardly known that the material for the Damascus blades, so celebrated in the middle ages and up to the last century, was made at Nirmal, a now rather important village in Hyderabad, from where Persian traders imported the same to Asia Minor, in spite of the great expenses, hardships, and even dangers they had to overcome to acquire this costly material from such an out-of-the-way country, and so very difficult of access at that time. The methods employed by the natives of India for the production of iron and steel of course differ in their details with the different countries where they are practised, they all correspond however in the following points:—

- (1.) All their methods are based on the use of *vegetable* fuel and no mineral fuel is required.
- (2.) They all used *compressed* air for burning their fuel.
- (3.) The methods are carried on on a *small scale* in each case.
- (4.) The quality of wrought iron or steel produced is in each case a *most superior* one.

The following is a description of a native iron work in Central India.

The smelting furnace is a shaft of clay, one foot square and three feet deep; this shaft is entirely filled with charcoal, and a charge of 40 lbs. of iron ore is heaped up

over it:—then the lighting and blowing commences. The bellows consist of two cylindrical leather bags which are pressed down alternately, whereby the compressed air is driven in a continuous stream into the oven through the funnels of clay, situated about nine inches above the bottom of the furnace. After a couple of hours' blowing, and several replenishings of charcoal, the smelting process is complete, when the master of the work draws from the bottom of the furnace, with a pair of tongs, an unshapely lump of iron, (called in the vernacular "Lotah,") weighing from 18 to 20 lbs.;—this is then dragged to the front of the building, when it is beaten with hammers till it is reduced to a disc of 6 to 8 inches in diameter and two inches in thickness. As the natives add nothing to the ore in the furnace, the loss of metal through slagging is considerable. In this manner the work is continued ceaselessly for 24 hours, after which the furnace requires repairing. During this time four laborers and one master are employed, the latter generally the owner of the establishment. The laborers relieve one another at the bellows, the master being employed in removing the metal ("Lotah" as said before) and in mending the oven and funnels.

The five men earn together during the 24 hours Re. 1-1, and turn out in this time two maunds of half-finished iron.

The refining and finishing processes are carried on in rough open forges, and the articles manufactured are horse-shoes, spades, clamps and other small objects. In the production of 1 to $1\frac{1}{2}$ maunds of finished goods (in 24 hours) there is a waste of 40 or 50 per cent. of iron, the consumption of fuel being three maunds. Six men and four boys work at two forges and earn in the aggregate Re. 1-12. Therefore, for the production of 1 to $1\frac{1}{2}$ maunds of finished goods from the ore (in 24 hours), there are employed five men in producing two maunds of half-finished iron, and six men and four boys in converting this into 1 to $1\frac{1}{2}$ maunds of finished goods; altogether 11 men and 4 boys who earn Rs. 2-13-0. The total consumption during this time is, of charcoal 9 maunds, and of ore $4\frac{1}{2}$ maunds.

The same quantity of iron goods made with the present European appliances would consume but $\frac{1}{3}$ of the fuel and $\frac{1}{2}$ of the ore used by the native method.

(To be continued.)

PROPERTIES OF FLUIDS.

By A. EWBANK.

II.

THE different degrees of fluidity or mobility of the particles or molecules of a body may be more simply illustrated as follows.

fig. 2.

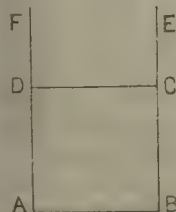
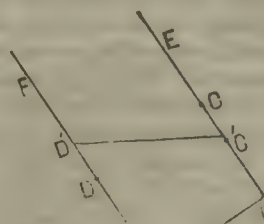


fig. 3.



Take as in fig. 2 a vessel of glass or any other material. Glass is preferable as being transparent, but it is not absolutely necessary for the experiment. ABEF denotes the vessel which may however have any shape whatever. Pour in water—having the base AB of the vessel horizontal—till the water reaches any convenient level C'D. Now tilt the vessel either *slowly* or *quickly* into such a position as is indicated in fig. 3. Then the water will have its surface at certain points, C', D', etc., which are different from the points C, D of the vessel. Endeavour by rapid

tilting to put the vessel into its new position before the water has time to take the position CD' . This we shall find not easy of accomplishment.

Now take the same, or a similar vessel, and pour in either the same quantity of treacle or a lesser quantity, if it is not convenient to use the same quantity. Repeat the tilting experiment, and we shall find it much easier to forestall the treacle—to put the vessel into some new position and then to watch the treacle more leisurely adapting its shape to the changed conditions. If the quantities of water and treacle are the same, and the vessels of the same size and shape, then the treacle will for the same tilt adopt ultimately the same shape as the water more rapidly adopted. This *ultimate* adoption of the *same* form under the same conditions we will call a characteristic feature of fluidity.

If we were dealing with the times taken respectively by the water and treacle to attain their final—their restful—positions we shall have to place water and treacle in different categories. But if we ask only what will finally happen, and do not ask how long a time is needed, then water and treacle go into the same class or category. What we have above called the final or restful position is usually described by mathematicians as the position of equilibrium. To this point we may presently return. Meanwhile we will seek for other manifestations of what we call fluidity.

Into such a vessel as we had in *fig. 2* let us pour a quantity of rough or coarse-grained salt, sugar, sand, chalk or any other sufficiently brittle substance. Let us fill the vessel to the level CD . Now tilt the vessel as before; we may tilt it slowly or tilt it suddenly. In neither case shall we obtain the same position CD' as we had with water or treacle. Having observed the discrepancy between our former and our present result let us hold the vessel pretty firmly in the position of *fig. 3*. Then with a spoon, stick or other object let us give the vessel a series of equally strong taps. We shall find the shape of the material changing. We shall find it tending to assume exactly the shape which the water quietly assumed without the aid of tapping and which the treacle more slowly assumed, but equally without the aid of tapping. As to the violence of the taps or blows they depend on the "grain" of the material.

Having noticed the tendency—under taps—of the substance to assume what we called the restful position, or position of equilibrium, let us empty the substance into a mortar. There it may be pounded till it is "finer-grained," that is, until it is reduced to smaller separate pieces. If we now return the substance to the vessel as in *fig. 2*, and tilt this vessel as in *fig. 3*, we shall still find that the substance has not exactly assumed the position CD' . Nor does it shew any tendency to assume that position if left to itself. But as before, we may by taps induce it to do so, and we shall find that the taps need not be so violent as before.

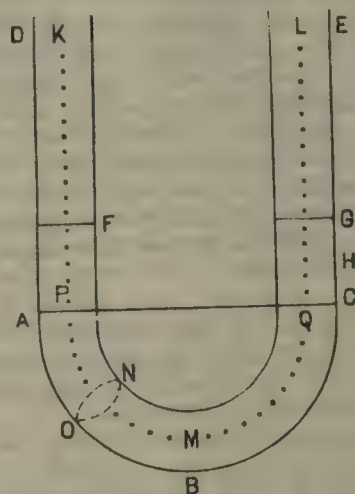
We might conceive that repeated poundings—say fifty consecutive poundings—would reduce the body to a very fine powder. We might conceive that in each case taps were needed, but that in each case these taps might be more gentle than were necessary in the preceding trial. But if we imagine that by a sufficient number of poundings the body becomes so changed that it moves of itself—be it quickly or be it slowly—into the same new position CD' as did the water or treacle; then we are virtually imagining that by sufficient poundings we can change a (partially) rigid body into a fluid body. We do not know any case in which mere pounding has actually produced such an effect. As far as modern science at present understands the question, we do by pounding merely separate molecule from molecule. That is, we change a group of say $x + y$ molecules into a group of x molecules and a group of y molecules, but we do not thereby induce an approach to fluidity.

If we raise the temperature of the powder the substance may indeed become fluid. But then when we return to the former temperature the substance is no longer fluid, and is not even in the state of a powder. So that

to reproduce the powder we must repeat our pounding processes. The precise effect of heat on the body is still only partly understood. Possibly it may affect the shape of the molecule. Possibly also the property of fluidity may depend on the shape of the molecule.

Not only does heat change a rigid body—say iron—into a fluid; but a body which is a fluid at one temperature may obtain an increase of fluidity—or of mobility of particles—by being given a higher temperature. But all that we at present are called upon to notice is that a fluid seems different from a powder, no matter how fine may be the "grain" of the powder.

fig. 4.



By another series of experiments we may bring out in another form the difference between powders and fluids. On a level table let us pour through a funnel, or simply from any vessel, a slow thin stream of powder. Let this powder fall vertically, and thus always along the same line. Then the powder will arrange itself on the table in what is called a heap. The appearance will be that of a little mountain. We may also describe the appearance by saying it is like a cone. The shape taken is roughly indicated in *fig. 4*. The powder falls down the line HK and on this line we find the vertex C of the cone. Now, though the vertex C is not truly a point, yet still the shape of ACB is to a certain extent angular.

If, on the other hand, we allow a thin stream of water or treacle to fall on the same table the fluid spreads out more uniformly. When the stream down HK has ceased, and when after some further lapse of time the fluid has settled into what we call its restful position, or its position of equilibrium, we have no signs of an angular prominence or vertical promontory such as we had at C. The depth of the fluid is more uniform, and any divergence from uniformity of depth is caused by the fluid having a curved—a convex—a rounded—surface. This continued curvature—this smoothness of outline—this want of corners—this ABSENCE OF ANGLE—is a distinguishing feature of fluids.

Horizontality of surface is not so special a feature of fluids. In fact, a fluid has its surface not strictly horizontal. Where the surface is not horizontal there is a gradual curvature. For instance, let us suppose an insect to fly directly across a river, *i.e.* at right angles to the banks, which we may suppose to be parallel, and for some little distance to be straight. Let the insect so fly as just to skim the water throughout its course. Then its path will be curved like the line of a bow when strung. A familiar example of the curvature of surface is given by the rain-drops that glisten on plants after a summer shower.

On the other hand, if we break a block of ice into fragments, these will have corners and edges that usually are very sharp. In weather sufficiently cold these edges could be used as cutting instruments for soft materials. When the ice melts it is always the edge that first disappears, and this edge is changed to a rounded surface.

NOTES FROM HOME.

(From our own Correspondent.)

The *Pall Mall Gazette* recently recorded an unprecedented feat in telegraphy when a day or two ago a prolonged interview took place by cable between their Commissioner at Vancouver and the Editor in London. The intervening distance was 7,000 miles of sea and land, and the conversation occupied three hours, with interruptions caused by a storm which raged in the far North-West. The message was transmitted by the Morse at Vancouver, was read off at Conso in Nova Scotia and retransmitted to Waterville where it was read off by the operator and retransmitted to London where it was recorded on a Wheatstone Receiver and read off at the same time by an ordinary Souder. A verbatim report of what was said is given and the whole is a striking manifestation of the extent to which time and space have been annihilated by the electric telegraph. It also demonstrates the growth of enterprise which has bridged the Dominion from sea to sea. It may be interesting to state that the cost of laying down the ordinary telegraph overhead wire is here given to be about £20 to £30 per mile in this country. A submarine cable costs about £150 to £200 per mile. The line between Vancouver and London consists of 4,500 miles overhead wire and 3,000 miles cable, the total cost of which may be roughly estimated at £150,000 for the land lines and £525,000 for the submarine section.

Scientific News, formerly a monthly publication, now appears weekly and promises in the present growth of science, and the efforts being made to effect the spread of technical education to be an extremely useful, interesting and valuable addition to the weekly technical issues of the day. In the first number thus published is given a short account of the Eiffel Tower, now being erected in Paris, which will probably be the most conspicuous object of the Exhibition to be opened there next year. Accompanying the article is an illustration of one of the bays, which gives a sufficient idea of the magnitude of the concern. The tower will be no less than 1,000 feet high, or about two and a half times the height of our St. Paul's Cathedral. A height of about 170 feet has already been attained and at this height the first platform will be erected, and M. Eiffel hopes to have this completed this month. In criticising this monster erection it referred to the difficulties that have to be overcome in getting men to work at hitherto unprecedented heights and the difficulties in rivetting in such a position—indeed the doubt was held out whether the fully intended height would ever be accomplished.

The *Standard* commends the courage of the French Government in refusing the application of M. de Lesseps for a lottery loan on behalf of the Panama Canal and points out the serious position in which financial houses of France will inevitably be placed when the collapse of the Company occurs. That this is certain very little doubt remains upon an investigation of the affairs of this costly concern, for it is now upon its last legs—there being no further hope that without the assistance of the Government another shilling can be raised. The original estimate was 28 million pounds. Seven years have passed and the actual expenditure is now put down at sixty millions, while the original idea of a sea level canal is abandoned for a canal with locks. All the money that has been raised has been raised entirely by the French people alone, for the reason that nobody but the French people ever believed in its accomplishment. Some forty millions of money have been thus placed by the nation in M. de Lesseps' hands. From time to time accounts have been received of the disastrous slowness with which the works advanced and of the immense waste that was going on. But the venerable projector put these down to the enemies of French progress, and the credulous people believed him.

It is estimated that the Canal cannot now be completed for less than another 25 million pounds. M. de Lesseps in his latest calculations considers that the tonnage of the shipping that will use the Canal will exceed that of the Suez Canal, and thus he obtains a revenue which enables him to parade before the public a net free income of three-quarters of a million after all fixed charges have been met. Such are the wild delusions of a mind overborne by the force of a fixed prepossession.

Several steam navies are already at work on the Eustham Section of the Manchester Ship Canal, the progress of which I intend to record from time to time. The first contingent of workmen will be increased until about 2,000 will be employed on this section alone. Each of these steam navies

will remove the surface soil at the rate of 1,200 cubic yards per day. The soil is then taken away by locomotives and wagons to suitable spots to be tipped. A special water-supply is being laid on, and a light railway running from Bromborough to Ellesmere Port is rapidly approaching completion.

According to the *Globe* the Metropolitan Railway Company have concluded an arrangement with the Electric Traction Company for experimental running upon a section of the Railway, outside the circle of a locomotive of the same power as the present steam locomotive. The Electric Traction Company stipulate that should the experiment prove an advantageous and economic method of working, they are to have the option of entering into an agreement for working the Railway by electricity for a term of five years at a rate per train mile to be agreed, such rate not to be in excess of the cost of working by means of steam locomotives.

The City authorities are contemplating lighting a portion of the City with electricity in the wide thoroughfares. Arc lamps of 2,000 candle-power at £26 each per annum or £4,394 in all, 169 of these lamps to replace 616 gas lamps at £2,246, the total illuminating power of the former being about 32 times that of the present gas lighting.

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

In Mexico there has been within the last few years a notable increase in railway mileage. There were only thirty miles of railway in that country twenty years ago; ten years ago this was increased to 676 miles and in 1880 there was only 987 miles. In 1881 this number had grown to 2,000 miles; and the spirit of progress which was started by citizens of the United States has shown remarkable results. In seven years nearly 3,000 miles of completed railways have been added, while a large addition of mileage is now under construction and more is projected.

News from Prescott, Arizona, report the discovery at a point ten miles from that city of a fabulously rich gold-mine. It is said to be the richest mine ever discovered in Arizona and perhaps in the world. The mine is located in the Santa Pata Mountains near the Hassayampa River. The ore assays \$1,000 per ton and thousands of tons are reported to be in sight. The gold is in a ledge 8 by 13 inches in width, and presents every appearance of being a continuous one.

The *New York Sun* thus describes the meeting of the steam drills in 6,000 feet of rock in the tunnel of the New Oron Aqueduct now being built for New York City's Water-Supply: "About three years ago two forty-pound lumps of lead were suspended by piano string wires in each of two holes 400 feet deep, and a lot of Engineers sighted across the lower part of the wires in each hole to get the exact direction in which to bore a tunnel through the intervening rock, so that the tunnels should meet each other 3,000 feet away. The holes were 6,000 feet apart and they marked the ends of one of the sections of the Aqueduct. The four big pieces of lead were steadied in tubs of oil, so that they would hang free and yet not vibrate like pendulums. A few days ago two drills working toward each other from the different headings met end to end. For several weeks the men knew that they were getting near to each other. The Engineer's figures had predicted it, but the clear rapping of the drills told a plainer and plainer story every day, and for several days the men have been able to make their voices heard, although there was fifteen or twenty feet of solid rock between them.

"This rock was the last barrier in 6,000 feet section, and there was strong rivalry between the men in the two headings. Each wanted to have the last blast. For safety, all blasts during the last few days have been made alternately. A blast usually takes out five feet. One day at 12 o'clock the foreman in the south heading, heard one of his drills striking against some metallic substance. Putting his ear to the drill, he heard another drill tapping away at it from the other side. The drills had met. The drills are run by compressed air at high pressure. Before putting a charge in a hole, a pipe is thrust in and all the mud blown out with a jet of compressed air. The foreman ran his blow pipe into the valve and turned on the air. A shower of mud told the story in the other heading. At 6½ o'clock the last blast was made and opened a hole about four feet in diameter."

There is considerable talk about the shutting down on 1st December of the Bessemer steel rail business of the entire country. The reasons for this are, the large mileage of

railroads built this year is not expected to be repeated next year on account of the expected stringency of the money market. Tight money would prevent the placing of contracts and result in depressing prices, which have already reached too low a point consistent with the price of iron and labor. Consultations have been held by the representatives of the twelve Bessemer rail works of the country, and the proposed action now under consideration will be harmonious. The old Bessemer Association will be reformed for the purpose of controlling the production and price of steel rails directly and indirectly.

The Annual Report of the Chief of Engineers, U. S. A., has just been made public. In it General Duane, the Chief, asks for \$2,810,000 for mortar batteries at the different ports of the United States, and \$1,860,000 for foundation and other appliances for submarine mines to close channels to principal ports, and \$31,000 for torpedo experiments.

Since operations were begun 230,000 tons of rock have been removed from Hell Gate, and the channel widened between Backwell's and Ward's islands to 320 feet, giving a depth of 22 feet of water at mean low-water mark. In mining 98,537 pounds of dynamite, 240,399 pounds of rack-rock, and 12,561 pounds of fulminate of mercury have been used. At Flood Rock 270,716 cubic yards of rock were removed at a cost of \$1,061,983. The total cost of the Hell Gate improvements the past fiscal year has been \$87,311.35.

The Erie Canal, about to be closed for the winter, has seventy-one locks, of which twenty-one are between Syracuse and Buffalo and fifty between Syracuse and Albany. The Oswego Canal has eighteen locks and lifts 155 feet. The twenty-one locks between Syracuse and Lake Erie lift 200 feet. Between Lake Ontario and the Hudson River the lockage amounts to 610 feet ascending and descending. Several of the canal locks are to be lengthened and general improvements are to be made in the canals and lock gates. The New York canals during the past twenty-eight years carried more than double the tonnage that was entered at New York City for the same length of time.

The sixteenth meeting of the American Society of Mechanical Engineers was held in the City of Philadelphia, beginning 28th November, and ending 2nd December. Some of the papers read were: *Method of Ventilating and Heating Office and Warehouses*; *Steel Car Axles*; *Power Press Problems*; *How to Test Strength of Cements*; *Influence of Sugar on Cements*; *Results Obtained from Steel tested shortly after Rolling*; *Read-d for Railroad Bridge Structures*.

Some of the papers to be read during the winter before the American Society of Civil Engineers are: *The Venturi Water Meter*; *Clemens Herschel*; *The Panama Canal*; *Lieutenant Rogers, U. S. N.*; *Long Span Bridges*; *G. Lindenthal*; *Classification of Railroad Accounts*; *Gratz Mordecai*; *Description of Work of Constructing a Dam across Potomac River for increasing the Water-supply of Washington, D. C.*; *S. H. Chittenden*.

The Society has received an invitation from its members residing in Milwaukee, Wisconsin, to hold its annual Convention of 1888 in that city, appropriately called "The Fair City of the Lakes."

SINGARENI COAL MINES.

(From a Correspondent.)

THESE mines have been formally taken over by the Hyderabad (Deccan) Company, Limited, under powers of the concession recently granted by the Government of His Highness the Nizam.

Mr Theo. W. Hughes Hughes, of the Geological Survey of India, has been appointed General Superintendent, a name which is a guarantee that the young industry will have the good scientific experience to assist in developing its growth. A staff of subordinate officials has been selected with great care from the Central Mining District of England, and consisting of men of tried capabilities in their respective branches will materially aid the management in the furtherance of practical detail. Nearly all the officials have had prior Indian experience and have had charge of some of the most thoroughly equipped collieries in Great Britain. The coal interests of the firm, therefore, may be said to be in good hands.

Prior to its transfer to the Hyderabad (Deccan) Company the coal had been touched on its outcrop by one producing shaft and several others also near the outcrop were proceeding towards coal.

Since the New Management took over charge on the 1st January, considerable vigor has been imparted to developing operations, and an incline has been put down to coal, which in breadth of conception and comprehensive detail promises to be the first of its character in India. It is purposed to command four square miles of coal by this operation and to put down a plant equal to an output of 1,000 tons per day. The most modern machinery has been ordered from England, including winding and pumping engines, ventilating fans, workshop appliances, patent picks, heading machines, compressed air engines, in short every mechanical expedient which will tend to minimise manual labor or cheapen production.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, February 11, 1888.

Upper Burma.

Mr. J. P. Henderson, Assistant Engineer, 1st grade, is transferred from the Chindwin to the Meiktila Division.

Lower Burma.

Mr. H. S. Guinness, Assistant Engineer, 1st grade, Burma State Railway (Dongon-Mandalay Extension), has passed, with credit, in Burmese by the departmental standard, as prescribed in the Public Works Department Code.

Madras, February 14, 1888.

Captain L. Lingey, Royal Engineers, Executive Engineer, 2nd grade, sub. *pro tem*, Madras, is permitted to return within period of leave.

Bombay, February 16, 1888.

Rao Sahib Parashuram Krishna Chitambar, L.C.E., Assistant Engineer, 2nd grade, has passed a colligible examination in Kannarese, in accordance with the Public Works Code.

Hyderabad, February 16, 1888.

With reference to Hyderabad Public Works Department Notification dated 25th November 1887, furlough to Europe on medical certificate for six months is granted to Mr. M. J. Sobie, Executive Engineer, 3rd grade, sub. *pro tem*, with effect from 16th September 1887, instead of 3rd September as therein stated.

Twelve months' furlough is granted to Mr. A. F. Higgins, Executive Engineer, 2nd grade, on special duty in the West Berar Division, with effect from 1st February 1888 or such subsequent date as he may avail himself of it.

With reference to Hyderabad Public Works Department Notification dated the 25th November last, extension of furlough to Europe on medical certificate for six months is granted to Mr. M. J. Sobie, Executive Engineer, 3rd grade sub. *pro tem*, attached to the South Berar Division.

Furlough for twelve months, with effect from the 15th February 1888, or such subsequent date as he may avail himself of it, is granted to Rao Sahib Waman Annant Bholey, Honorary Assistant Engineer, 2nd grade, East Berar Division.

Central Provinces, February 18, 1888.

In continuation of Central Provinces Notification of 10th current, Mr. J. B. Leventhorpe, Executive Engineer, surrendered, and Mr. D. Wallace, Executive Engineer, assumed charge of the Eastern Division, on the afternoon of the 3rd February 1888. Mr. Leventhorpe, Executive Engineer, is posted to the Chief Engineer's Office on special duty.

Mr. G. G. White, Executive Engineer, 3rd grade, Kanhan Division, is granted 23 days' privilege leave, from such date as he may avail himself of it.

Mr. G. M. Harriott, Executive Engineer, is appointed to the charge of the Kanhan Division during the absence of Mr. White on privilege leave, or until further orders.

N.-W. P. and Oudh, February 18, 1888.

Irrigation Branch.

Mr. A. H. Barron, Executive Engineer, 1st grade, sub. *pro tem*, Allahabad Division, Ganges Canal, is granted nine months' furlough, with effect from the 15th March 1888, or such subsequent date as he may avail himself of the same.

Mr. J. H. Thornhill, Executive Engineer, 2nd grade, Bhognipur Division, Lower Ganges Canal, is granted eighteen months' furlough, with effect from the 15th March 1888, or subsequent date.

Buildings and Roads Branch.

Mr. A. C. Crompton, Executive Engineer, 4th grade, is, on return from privilege leave, posted temporarily to the office of the Executive Engineer, Meerut Provincial Division.

Mr. W. C. Wright, Executive Engineer, 1st grade, Divisional Engineer, Lucknow, is granted furlough in India for two years.

India, February 18, 1888.

Lieutenant H. C. I. Birdwood, R.E., temporary Assistant Engineer, 2nd grade, Punjab, is permanently appointed to the Department in that grade, with effect from the 8th August 1886.

Mr. R. Buxter, Executive Engineer, 2nd grade, sub. *pro tem*, State Railways, is temporarily transferred to Burma, Provincial Establishment.

Lieutenant Charles Stuart Rose, R.E., is appointed to the Public Works Department as an Assistant Engineer, 2nd grade, and posted to State Railways. Lieutenant Rose is placed at the disposal of the Director General of Railways.

The Governor-General in Council is pleased to order the following temporary promotions and reversions of Chief and Superintending Engineers, with effect from the dates specified:—

Colonel B. Lovett, C.S.I., R.E., Superintending Engineer, 2nd class to be Superintending Engineer, 1st class, with effect from 25th September, 1887.

Major W. G. Nicholson, R.E., Superintending Engineer, 3rd class, to be Superintending Engineer, 2nd class, with effect from 25th September 1887.

Major W. G. Nicholson, R.E., Superintending Engineer, 2nd class, temporary rank, to be Superintending Engineer, 3rd class, with effect from 25th November 1887.

Mr. G. W. MacGeorge, Superintending Engineer, 3rd class, temporary rank, to be Executive Engineer, 1st grade, with effect from 25th November 1887.

Colonel G. E. L. S. Sanford, C.B., R.E., Chief Engineer, 1st class, temporary rank, to be Chief Engineer, 2nd class, with effect from 14th December 1887.

Mr. F. L. O'Callaghan, C.S.I., C.I.E., Chief Engineer, 2nd class, temporary rank, to be Chief Engineer, 3rd class, temporary rank, with effect from 14th December 1887.

Mr. H. Bell, Chief Engineer, 3rd class, temporary rank, to be Superintending Engineer, 1st class, with effect from 14th December, 1887.

Colonel B. Lovett, C.S.I., R.E. Superintending Engineer, 1st class temporary rank, to be Superintending Engineer, 2nd class, with effect from 14th December, 1887.

Major W. L. Greenstreet, R.E., Superintending Engineer, 2nd class, temporary rank, to be Superintending Engineer, 3rd class, with effect from 14th December 1887.

Mr. T. H. Wickes, Superintending Engineer, 1st class, temporary rank, to be Superintending Engineer, 2nd class, with effect from 19th December 1887.

Mr. H. A. S. Fenner, Superintending Engineer, 2nd class, temporary rank, to be Superintending Engineer, 3rd class, with effect from 19th December 1887.

Mr. R. H. Rhind, Superintending Engineer, 1st class, temporary rank, to be Superintending Engineer, 2nd class, with effect from 15th January 1888.

Mr. T. Higham, Superintending Engineer, 2nd class, temporary rank, to be Superintending Engineer, 3rd class, with effect from 15th January, 1888.

Colonel C. J. Smith, R.E., Chief Engineer, 2nd class, temporary rank, to be Chief Engineer, 3rd class, with effect from 17th January 1888.

Mr. J. W. Wright, Superintending Engineer, 1st class, temporary rank, to be Superintending Engineer, 2nd class, with effect from 17th January, 1888.

Major J. W. Ottley, R.E., Superintending Engineer, 2nd class, temporary rank, to be Superintending Engineer, 3rd class, with effect from 17th January 1888.

Baluchistan.

With reference to the Government of India, Public Works Department Notification, dated 28th December 1887, Mr. Charles Evans, Executive Engineer, 2nd grade, was attached to the office of the Superintending Engineer, Baluchistan Agency, from the 30th November 1887, to the 23rd December 1887, on which date he reported his departure on transfer to the North-Western Provinces.

Director-General of Railways.

With reference to Public Works Department Notification, dated 4th February 1888, Lieutenant Philip Geoffrey Twining, R. E., Assistant Engineer, 2nd grade, is posted to the North-Western Railway.

Bengal, February 22, 1888.

Establishment—General.

Mr. J. R. Swinden, Executive Engineer, employed on the Tirhoot State Railway, is appointed to be Executive Engineer of the Pooree Division.

Mr. J. T. Boase, Executive Engineer, is, on return from privilege leave, posted temporarily to the Tirhoot State Railway.

Mr. E. R. Gardiner, Assistant Engineer, temporarily employed on the Eastern Bengal State Railway, is appointed to officiate as Executive Engineer of the Bhagulpore Division, during the absence, on special leave, of Mr. D. F. Martin, Executive Engineer, or until further orders.

Mr. C. H. DeMello, Assistant Engineer, has been granted by Her Majesty's Secretary of State for India an extension of leave for three months without pay.

Mr. C. A. Mills, Executive Engineer, second Calcutta Division, on privilege leave, is appointed to Inspector of Local Works in the Chittagong Division.

Rai Madhub Chunder Roy Bahadur, Officiating Inspector of Local Works in the Dacca Division, is to officiate as Inspector of Local Works in the Chittagong Division in addition to his own duties, during the absence of Mr. Mills, on privilege leave.

Mr. A. McD. Salmon, (Assistant Engineer), District Engineer of Patna is granted furlough for one year and eight months, with effect from the 15th April next, or such subsequent date as he may avail himself of it.

Establishment—Irrigation.

Mr. C. A. White, Assistant Engineer, Arrah Division, is granted privilege leave for 21 days, with effect from the 26th instant, or such subsequent date as he may avail himself of it.

Mr. J. P. Scotland, Executive Engineer, having reported his return from furlough on the forenoon of this date, is appointed to be Executive Engineer of the Cossye Division. Mr. Scotland is granted an extension of furlough for three days.

With reference to the above notification, Mr. G. A. G. Shawe, Executive Engineer, on being relieved by Mr. Scotland, will take up the duties of his substantive appointment of Executive Engineer of the Circular and Eastern Canals Division.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 15th February 1888.

141 of '87.—Henry Hamilton Remfry, Solicitor and Patent Agent, of 5, Fancy Lane, Calcutta.—For a mode of preventing induction in telegraphy, telephony and the like, and apparatus therefor.

143 of '87.—Henry Hamilton Remfry, Solicitor and Patent Agent, of 5, Fancy Lane, Calcutta.—For improvements in automatic telegraphy and apparatus used therefor, parts of which are applicable to ordinary telegraphy.

8¹ of '88.—James Wainwright, Pattern-maker of Greenheys, Manchester, in the County of Lancaster, England, and Henry Briggs, Plumber, of Moss Side, Manchester, aforesaid.—For improvements in automatic fire-extinguishing apparatus.

13 of '88.—Evan Rowlands, of No. 116, Collins Street, West, in the City of Melbourne and Colony of Victoria, aerated water manufacturer.—For improved apparatus for drawing aerated liquids from fonts or reservoirs.

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PORT OFFICE, BOMBAY; } Port Officer of Bombay,
January, 18 1888. } (64)

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ANSWERS TO CORRESPONDENTS.

"C. W. HODSON," "W. G. BLIGH," "E. E. RUSSELL TRATMAN" (U. S. A.), "F. R. A. S.," "EXECUTIVE," "J. T. ROBINSON."—In our next.

"J. E. BONJOUR" (Cuddalore).—Thanks; but the types of roofs furnished are very common in Upper India.

"DUMPTY LEVEL" (Jamalpure).—Not authenticated—declined.

INDIAN ENGINEERING.

SATURDAY, MARCH 3, 1888.

JOURNALISTIC ENTERPRISE.

THE conditions under which journalistic enterprise flourishes in England are so dissimilar with those which obtain in India that it would be idle to hazard a comparison between the two. The difficulties that beset the ordinary newspaper are great, but they are almost insurmountable in the case of a technical journal. The latter must stand or fall on its own merits or demerits. If it supplies a want, it behoves all interested in its welfare, that is, those for whose benefit it is kept up, to come forward and support it, not only by subscriptions but by contributions as well. In regard to a professional paper this helps in a great measure to generate an *esprit de corps*, on the part of its conductors as well as its supporters, quite apart from mere pecuniary consideration or trade affinities. Without an unity in thought and the interchange of reciprocal feelings, such a venture—of which independence is the essence of success—can hardly hope to thrive.

It has been hinted to us to apply for State aid in the prosecution of our work, but grave and solid reasons deter us from accepting such a suicidal policy. We could not do so consistently with our position as a journalist, and looking to the character of our journal as an independent exponent of the professional opinion of the country, a subsidy from Government would imply a death-blow to all our hopes and aspirations, for we are as yet far from the state or condition when there would be any justification for selling our birth-right for a mess of pottage. Ever since we started the journal, the cream of the profession have rallied round our banner, and it would be an insult to their understandings should we stoop to any device for securing extraneous aid. We are well aware of the obligations that would follow; we would have to bid adieu to our cherished traditions. State aid would hamper free expression of thought, or exempt Government from adverse criticism, and as all human institutions are liable to err on the score of faulty judgment to which no moral turpitude could be assigned, we would be withheld from doing our duty simply on the ground of incurring somebody's displeasure. On the other hand a free and liberal Government is always glad to entertain—in fact courts—criticism when not dictated in a carping, captious spirit. It would therefore detract from our usefulness if we permitted ourselves to be led away from the path of duty for any, much less pecuniary, consideration. Our occupation would have gone, and we would be instrumental in cutting away the ground from under our feet.

Any specialistic journal that seeks to curry favour with Government must be in a bad way, as far as its *clientele* are concerned, for it bespeaks a want of confidence in the proprietary that should be its mainstay. That we are not singular in our opinion will appear from

the history of "*Roorkee Papers*," a quarterly journal which was the property of Government. All official prestige that could be lent to give it a stable footing was unsparingly accorded, and yet it died of sheer inanition. It failed not on the score of "no money—no paper, no pay—no editor." It was rather a case of plenty money but no matter. We would note here that with inducements of premiums for articles ranging from two gold mohurs to Rs. 200, the venture collapsed for want of materials to build up a technical journal. The *Papers* were purely professional, and there was that absence of wider social and general sympathy which is a *sine qua non* in a journal of the present times. Its exclusiveness was fatal to its progress. We would therefore be following in the same wake and courting similar disaster were we to abandon our present policy in favour of one which to say the least of it has been weighed in the balance and found wanting. All that we need is a fair field and no favour, and even should Government fail to take as much cognizance as we could wish of the journal, which has a wide circulation amongst the various Engineering Services of the country, as a medium for such Railway and Public Works advertisements as are not of a purely local character, we feel assured that they must eventually see that that course is neither profitable nor just to either the exchequer or the tax-payer, and be led to follow the practice of Europe and America in such matters.

PUBLIC INSTRUCTION IN ENGINEERING, ART, AND INDUSTRY IN BENGAL.

THE Secretariat Blue Book on the meanderings of public instruction in Bengal during the official year 1886-87 is a State Paper interesting and instructive. But our concern therewith is restricted to the welfare and progress of Engineering and Technical schools. In that connection we note a falling off in the number of students at the Seebpore Engineering College from 52 to 44. Only two students passed in the University B. E. and L. E. examinations. At the College examinations the rule compelling engineer students to undergo an examination in shopwork came into operation for the first time. Of the nineteen second year-wallahs who presented themselves eight were translated to the third year class. Of the fifteen first year students examined, twelve got promotion. All the fifteen passed practical work, we are glad to observe. Nineteen students joined the first year class; but of these eight subsequently withdrew, "*some complaining that the combined class and shopwork was too severe, others that the result of the F. E. examination was disheartening.*" The italics are ours. With reference to them we would remark that out of such flabby, fragile, easily discouraged material, competent engineers are not, and cannot be, made. A profession priding itself on its aptitudes for hard work is well rid of such eleemosynary *incubi* and *succubi*.

On the 31st March 1887 the Apprentice Department of the Seebpore College contained 102 students against 107 in the previous year. It is noteworthy that amongst

them there was but one Mahomedan. Five sub-overseer's and two overseer's certificates were granted during the year—a meagre outcome of educational endeavour, surely! Perhaps frequent choppings and changes in the teaching staff had something to do with it. Mr. Gilmore, head master in the Apprentice Department died in April 1886, and was succeeded by Baboo Upendro Nath Chatterjee, who resigned shortly afterwards, and gave place to Baboo Banku Behary Mookerjee. Then Mr. Gilliland appears to have had charge until he took privilege leave, when his work was temporarily distributed among the other professors. Mr. J. T. Simpson was the Executive Engineer in charge of the workshops in the first half of the year, Mr. J. H. Toogood in the last. And the moral is that frequent change of cooks may spoil broth as effectually as too many cooks.

The Survey operations of the second and third year engineer classes commenced at Madhupur in November 1886, under the superintendence of the Principal and Baboo Dwarkanath Dutt. The third year students laid out a line of railway about five and a half miles long, connecting two points on the East Indian line. On their return to College they plotted maps and sections, and designed and drew the various structures required. The second-year students surveyed a tract of country about three miles long, partly by triangulation, and partly by traverse, filling in the details by the plane-table. The first year class made a chain and compass survey of the Botanical gardens, and learnt levelling. The first, second, and third year apprentices made surveys and sections in the neighbourhood of the College. The fourth year engineer class visited, under the superintendence of Mr. Slater, various Engineering works, and we agree heartily with the Principal of the College in his opinion that such domiciliary visits are, educationally considered, of great use to students. We are sorry to have to record as a contrast to this outdoor encouragement of energy that the College Athletic Club languishes owing to lack of energy on the part of students, and lack of funds. Cooper's Hill has a very different tale to tell; and it accounts for some portion of the successes won by Cooper's Hill men, and an appreciable moiety of Seebpore failures in actual, active life.

The unpopularity of the Seebpore College was officially recognized a couple of years ago, when the Board of visitors appointed a Sub-Committee to enquire into such reason as might exist for disaffection. This Sub-Committee recommended.—(1) Appointment by the University of a Board of Examiners in Engineering for a term of years. (2) Reservation of a certain number of appointments for passed students of the College. (3) Discontinuance of the combined system of theoretical and practical work in the case of students of the Engineer Department. (4) Revision of courses and standards, and the amount of time devoted to them. These recommendations were laid before Government and another Committee was appointed to consider them. And so, in circumlocution and office cupboards, the matter ends probably?

The Director of Public Instruction in Bengal says that the Government School of Art, at Calcutta, is the most important institution he has official cognizance of, under the official heading *Art and Industry*. Nevertheless, the information afforded as to what this bulwark of Art has *done* is extremely meagre. We fail to see, moreover, what it has had to do with the genesis of an Industrial School founded by the Society for the Propagation of the Gospel, and why affiliation to it should be claimed. We can discover no ground for anticipation of useful exemplary work from the five ex-students who are said to have joined in starting a studio in Calcutta, and who have not since been heard of. We think that anyone who pays a visit of inspection to the premises in Bow Bazar where the Government School of Art has found refuge, will agree with us that it is a sham and a snare. We note that M. Ghilardi who was until lately officiating principal of the school, *anticipates* a large accession of students in the metal-chasing and wood-carving classes, and *expects* that certain elegant coffers designed and executed by his pupils will attract much attention at the Glasgow Exhibition, and probably sell for a considerable sum. But, as luck will have it, anticipations and expectations don't count for much now-a-days: wishing is not always having in the utilitarian time we are living in. An innovation has, we are told, been introduced into the School's Architectural class, inasmuch as students belonging to it are now made to draw from Indian architectural models; especially from the Bhuvaneshvar casts. A proposal is to the fore, to make them copy, on an enlarged scale, the archæological plates issued with the *Art Journal*.

Can Eastern-world and Western-world ideas about Art, canons and crucibles of Art, ever be reconciled, ever be brought into harmony? We shall be prepared to believe that they can when the Ethiopian changes the colour of his skin, and the leopard gets rid of his spots. But not till then.

The local authorities, not being satisfied with the working of the Ranchi Industrial School during the last two or three years recommended its extinction. *Dis aliter visum*. Government favours its up-keep, for the sake of the 27 pupils on the rolls, whose work is admittedly "not superior" to that turned out in the Bazar. The Berhampore Technical School had 27 pupils on its rolls in 1886-87, against 93 in the previous year "*when the school was a novelty*." Again the italics are ours. Midnapore can show better results than Berhampore, though there is room for a good deal of improvement.

On the whole we cannot say that the array of facts connected with technical education in Bengal, into which the Report we have been considering gives some insight, is in any efficient degree satisfactory or encouraging. We can only hope in that connection that there is a good time coming when Bengalee conservatism will have got used and reconciled to progress, and will be prepared to take advantage of the opportunities vouchsafed it. Meanwhile, as a Spanish proverb suggests, it is perhaps just as well when you cannot get just what you want, to make the most of what you have got.

THE UNCOVENANTED CIVIL SERVICE ASSOCIATION.

SILENCE is golden, says the proverb; but then it was invented long years ago, before the days of Radical ascendancy and the Punic faith of Caucasians; in times when fair play was a jewel. In the times we are living in silence is too often held to mean abject self-abnegation, an assenting to the yoke of injustice. It is apt to be regarded by people in power as warrant for perpetuation of injuries. Is *reliquium temporis acti*, in need of revision to suit altered circumstances. We are glad that the Indian Uncovenanted Services have at length discovered this truth, and have begun to organize and to agitate about their grievances; for that is the only way to get them remedied.

When people live in a golden age, silence may be golden, and gentlemanly, and commendable; but circumstances alter cases, and under existing dispensations we rejoice to find the Uncovenanted Services showing that they can conduct an agitation that has been forced on them in a gentlemanly way, and at the same time in a way that holds out hope of being more golden than silence. Absence of rant and fustian, equally at the meetings held out here and in London to ventilate service grievances and seek redress, has been one of their marked, one of their satisfactory characteristics. It will help to secure English support for a cause from which it might otherwise have been withheld.

Remedy for the wrongs of the Uncovenanted Services must come from England; from Parliamentary and outside pressure brought to bear on the stolidity of the India office, and the jealousies of the Indian Government. Mr. Henry S. King M.P. has been devoting his energies to this object, doing yeoman's service for it for some time past, and there are signs and tokens that his efforts are beginning to secure attention in the proper quarters. He deserves the thanks and gratitude of all members of the Uncovenanted Services for his disinterested championship of their cause; and he has surely worked hard enough for it to deserve success as a crown to his endeavours. Meanwhile he goes on steadily with his good work. Much work is done in the world which does not show its immediate result, he says hopefully. The last English mail brings an account of the proceedings at the first annual meeting of the Uncovenanted Civil Service Association, held in offices (45 Pall Mall) use of which for Association purposes Mr. King allows free of charge. The Committee's report submitted to the meeting informs us that the first step taken by that body was to issue a circular inviting the whole of the services to unite in an endeavour to obtain a fair review of their position, and redress of the grievances they have to complain about. This appeal was cordially welcomed and supported throughout the services. As a consequence, branch Associations and Committees have sprung into active life in nineteen districts in India, and are connected with the Central Association in London. The Anglo-Indian Press has cordially backed them up and upheld their cause.

Anglo-Indian opinion in some high places, and all middle-class places, is with it. Some members of the Service, while at home on furlough, have freely devoted time and brains to the Committee's work. Others again have contributed liberally towards the expenses of the campaign. By the way, we desire to invite special notice to what is written in the report about those said expenses:—"If justice is to be done to the cause, the expenditure will need to be considerably larger than it was in the past year; the Committee invite those who have not yet contributed to the funds to do so now, and thus strengthen their hands." An abstract of the Association's account shows receipts £546-10-9; expenses £227-15-11; Balance in bank £318-14-10. Not much of a reserve to carry on the war with.

Some people thought, or hoped, that there was a remedy at law for India Office and Indian Government repudiation of at any rate implied contracts. In order to get as near as possible to certainty in the matter, Mr. King at his own expense submitted a case for the opinion of an eminent leader of the English Bar. His verdict was that, although a strict interpretation of Service Rules affords the Uncovenanted Services no hope of redress, yet an appeal to Government on grounds of equity, justice, and, good faith, was amply justified.

So far, however, such appeals have proved of no avail. Those interested must go forward to action and organization. As Sir Roper Lethbridge put the matter at the London meeting:—"If they forced their claims upon the attention of the Government at home, if they induced every Member of Parliament over whom they had any influence, not only to speak to Lord Cross and Sir John Gorst, but also to speak in the House of Commons upon the subject, then they would obtain redress; not otherwise." Sir Roper, in this speech—in the course of which he laid claim to the honour of belonging to the Uncovenanted Civil Service—insisted that where there are various sets of men, all engaged in the honourable employment of working for their country it is preposterous that one small department should arrogate to itself a claim to all patronage, all the highest posts, all the fat things going in the way of pension, whilst a large number of departments are left out in the cold.

The men belonging to them undertake duties similar in character to those upon which members of the Covenanted Service are employed; they are more in number than the Covenanted Service; there can be no valid reason why the Departments to which they belong should not be fully represented in the administration of the Empire of India. The Public Works Department, Sir Roper said, was sometimes represented by Military officers, and he had the greatest respect for many of them; but at the same time he was unable to see any valid reason why it should be a *sine qua non* that the magnates of the great Public Works Department all over India should be Army men instead of Civil Engineers. Similarly, the Finance, Education, Forest, and Telegraph Departments ought to be better represented in the administration than they are at present. We are somewhat surprised that Sir Roper did

not improve the opportunity to refer to the special and notorious grievances of the Telegraph Department; but there seems to have been a desire to avoid long speeches; and the Association's programme offers pot-luck and no more to all alike, we suppose. For the rest, Rome was not built, *totus teres atque rotundus*, in a day. Mr. Talboys Wheeler, we note, made occasion to comment on the need for better union between Engineers and other Uncovenanted Civil Servants in India. We have never heard of any such friction between them as Mr. Wheeler's remarks infer; not even from those splenetic Burmese marshes where most of his service was spent has any tale of the sort reached us and we can vouch for it that on the Indian continent at any rate, far from there being anything like friction, there is cordiality, and "union." It is especially a pity that foundationless suggestions of splits in the Uncovenanted camp should be made just at this time. And what can be the use, the fun even, of giving outside heathen excuse to blasphemy? As a mouthpiece of the Profession of Engineering in India, and conservator of its honourable traditions we protest against the calumnious imputation conveyed in Mr. Wheeler's inunendo. It was the only harsh note, the only note in the least out of tune throughout the proceedings at the London Meeting.

Returning to Sir Roper Lethbridge's speech, we find him denouncing as scandalous the way in which the Government of India has treated its officers in the Uncovenanted Civil Service. It was, he said, simply because of an accident that terms as to pay and pensions had been stated in rupees instead of in sterling. And now, taking an unworthy advantage of the accident, Government turns round, and says:—"Although possibly we might not have paid you two shillings and two pence for every rupee of your pensions if the rupee had gone up to 2s. 2d. still, now that it has gone down to 1s. 4d. we shall not pay you one half penny more than that, because your agreement is for rupees, not for sterling." Sir Roper endorsed Mr. King's protest that no private employer of labour would dare or dream of treating his employes in such a manner. That will be a good nail to hammer at in England. If only English people can be got to realize in what an un-English way the Indian Uncovenanted Services are taken a mean advantage of by Government—why, the battle will be won. Meanwhile, we trust that all members of those services, in all departments, will co-operate with the Association, whether they happen to be Chief Engineers, Directors of Public Instruction, Heads of Forest or Telegraph Departments, or Finance Bureaus, or only incipient Deputy Magistrates, or Artists working in the Surveyer-General's office. A long pull, a strong pull and a pull altogether is what is needed now to secure Uncovenanted men against invidious distinctions in the line of promotion and equitable pay and pension rules—rules more suited to the times we live in, and Government's character for just dealing—than those that were framed for older generations in times when the rupee was worth two shillings, and living was very much cheaper than it is now.

Notes and Comments.

THE INDO-BURMA RAILWAY.—Mr. Guilford Molesworth will go into the question as to the best route for the contemplated extension of the Toungoo-Mandalay line northwards to connect with the Indian system.

A WISE COURSE.—We understand that the office of the Director-General of Railways with the Government of India will be amalgamated with the Public Works Secretariat from the beginning of the new financial year.

MANDALAY MUNICIPALITY.—Count Calderarj, formerly Municipal Engineer of Prome, has been appointed Municipal Engineer of Mandalay. The vacancy at Prome is to be filled up by two appointments, one as Secretary and the other as Supervisor, as advertised in the *Rangoon Gazette*.

THE KHWAJA AMRAN EXTENSION.—The *I. D. N.* says that Mr. F. L. O'Callaghan, C. S. I., C. I. E., Engineer-in-Chief of the Sind Pishin Railway, came down to Calcutta on a flying visit of a couple of days to discuss verbally certain details in connection with the Khwaja Amran extension.

ANOTHER RAILWAY COMPANY DOOMED.—As next year will be the first period of time at which, under the terms of the Contract with the South Indian Railway Company, the Secretary of State may purchase that railway, it is reported that arrangements are in contemplation for this being done.

ALLAHABAD WATER SUPPLY.—The Allahabad Municipality have received a letter from the Government of India insisting that no steps shall be taken towards promoting a scheme of water supply for the station until the opinion of an expert has been taken, and his report considered by the Government.

GEOLOGICAL SURVEY OF INDIA.—Dr. King, the Director of the Geological Survey, has started on a tour partly to visit Dandot Colliery works and the Salt Range and the Oil districts in Rawal Pindi, likewise into Beluchistan to see the Katan oil region and the coal area in the Harnai and Bolan country towards Quetta.

"IGNOMINY AND DISGRACE."—What has our Correspondent "Determination," whose letter appeared in our issue of the 18th January, and whose words we quote, to say to this:—"Wanted an Overseer for the Madura Municipality on a salary of Rs. 55 + Rs. 12 (horse allowance.) A. B. C. E. will be preferred"?

INDIAN RAILWAYS.—A Telegram dated London, February 27, says that the House of Commons has authorized the raising of 10½ millions for the purchase of the Oudh and Rohilkund Railway, and has also sanctioned the raising of ten millions for the construction, extension and equipment of railways in India through the agency of the various Companies.

THE LAST OF THE SUAKIN AND BERBER RAILWAYS.—The Secretary of State for War announces that he is prepared to receive tenders for trollies, rails, trucks, vertical boilers, ballast-waggons, fish-plates, chairs, bolts, washers, and other strangely named things which formed part of the famous railway which began at Suakin and never got to its destination.

BOMBAY FOREST REVENUE.—The forest revenue in the different districts of Western India for the past official year, shows as follows:—Northern Circle Re. 1-2 per acre, Southern Circle Rs. 5-1 per acre, Sind Circle Rs. 4-11 per acre. This is certainly a remarkable result as regards

Sind, whose wretched jungles are but a sorry contrast to the magnificent teak forests of the Southern Circle.

THE HOOGHLY NEW BRIDGE.—To Mr. Duff-Bruce, Vice-Chairman of the Port Commissioners, at present on furlough in England, is due the proposal to replace the present Floating Hooghly Bridge, which has already had several narrow escapes from vessels adrift, by a permanent structure. The proposed bridge—to which we have already referred—would be above the present one at Ahiritola.

FRANCE VERSUS ENGLAND RE CHINA.—The French, who are sorely afraid that the English will arrive at the frontier of China with a railway from Burma before their projected lines are completed, are struggling hard to get a commencement made with railway work in Tonkin. M. Constans, the Governor of Indo-China, has promised that contracts will shortly be asked for the lines, Hanoi-Langson and Hanoi-Laokai.

THE LUCKNOW ARTESIAN BORING.—The first pipe for the artesian well is to be placed early this month. This is the mode in which the Municipality after much deliberation has resolved to spend its savings, and if the venture prove successful it could not be better spent. Due care has been taken that the failure that occurred at another station shall not occur here. The best French and American authorities have been consulted.

GENERAL FISHER, R. E.—This Officer having offered to submit a large project for irrigating a large extent of country in the Raichore Doab, the Irrigation Board wish to know what terms an officer of General Fisher's standing would care to accept. At the same time Mr. Palmer, the Chief Engineer, P. W. D., is requested to ascertain from General Fisher on what terms he would prepare plans and estimates for the project he refers to, leaving the question of its being eventually carried out to future consideration.

THE INDIAN TEA TRADE.—In the year 1876-77 the total exports of tea from India were a little below 28 million lbs., and in 1885-86 they were nearly 70 million. The deliveries of Indian tea in London rose from 68½ million lbs. in 1886, to 83½ million, or by 21 per cent. in 1887; while those of China tea declined from 142½ million lbs. in 1886, to 119½ million lbs. in 1887, or by 16 per cent. The deliveries of Ceylon tea advanced from 6½ million lbs. in 1886 to 10 million lbs. in 1887, or by 40 per cent.

THE NEW CHENAB BRIDGE.—A small war is waging regarding the details of the rival plans for this structure, and as we are committed to the policy of strict neutrality, we defer entering into the matter till later on. We may observe, however, that the controversy has been characterized by injudicious advocacy, likely to do more harm than good so far as the cause of the Civil Engineers in the country is concerned, and all the more to be regretted because of the foolishness of the arguments employed.

ARCHITECTURAL RESTORATION IN LUCKNOW.—The Hossainabad trustees are about to lay out a large sum (Rs. 20,000) in the great Imambara and its buildings, from the minarets of which some of the best views of Lucknow can be had. The great Imambara itself is, like Westminster, one of the largest halls in the world, only it is devoted to prayer and not to law. The trustees have already built a huge clock-tower which reminds one of an Italian campanile without a Duomo, unless the Imambara be regarded as the Duomo.

ANOTHER ARTESIAN WELL.—The Municipal Commissioners of Negapatam have made a provision in the budget for 1888-89 of Rs. 1,000 towards the continuance of the boring of the artesian well in that town, in addition to Rs. 1,000 provided for the same work in the revised budget. A depth a little over 154 feet has been reached, but without any result. From the geological conformation of the district, the Collector is inclined to doubt whether anything is to be gained by continuing the boring. We are disposed to think otherwise.

MINING IN CHINA.—It is stated that the Chinese Government are about to undertake the opening of mines in different parts of the Empire. The Pingtu gold mines in Shantung are to be worked on regular methods, the copper mines of Ping-ch'uan Chow, and the Jeho galena mines are to be submitted to the best modern metallurgical processes under a foreign engineer, while the gold fields of Manchuria, the iron and coal mines of Shensi, Shansi, Chihli, and the copper lodes of Yunnan are to be worked at the instance of the provincial authorities.

THE E. B. S. R. AGAIN.—We learn that a serious accident occurred on Monday last on the Eastern Bengal State Railway. The down train was run into by a goods train coming in the opposite direction, and we hear that many of the passengers by the former train have been seriously injured. The collision occurred just above Kanchrapara Station, when both trains were 'slowing down.' A contemporary is informed that the line is blocked for a considerable distance, and is led to understand that the Railway authorities are doing their best to hush up the affair.

THE ORISSA COAST CANAL.—We glean that the first portion of this line of water communication was opened for trade in July 1885. In the nine months following the total quantity of traffic amounted to somewhat over 3½ lakhs of maunds, while in 1886-87 it rose to over 16 lakhs of maunds. In speaking of the Canal the Executive Engineer of the Balasore Division observes that though it is yet premature to speak of the whole Canal, there is every indication of the excellent beginning made developing into a prosperous future when the other ranges are complete and the Hidgellee Tidal Canal remodelled, and a through line of communication thereby opened.

THE RANGOON PORT TRUST.—The Budget Estimate for 1888-89 of the Port Trust is now ready. The total figures on the Receipt side of the Budget approach to Rs. 13,89,600 for the year 1888-89 as against Rs. 7,95,970 shewn in the provision for the year 1887-88. The gross expenditure is calculated at Rs. 14,44,900 for the year. Public Works Expenditure alone absorbs Rs. 3,83,100 for the year under review, and this is about Rs. 1,60,000 more than the figures of the preceding year's provision, due mainly to the proposed erection of new godowns, jetties for passengers &c., all of which it is the intention of the authorities to build in due course.

MARMAGOA HARBOUR.—In connection with our previous remarks on this subject, we now learn that the West of India Portuguese Railway, which is now in direct communication with the Southern Maharatta Railway, has determined not to lay out more money till the single ghat line pays. Only one half the Marmagoa breakwater has been completed, and during the monsoons, or high winds, as there is really no protection for even one steamer, business at the port will, in a great measure, be suspended. The harbour works have been stopped, and the staff employed thereon have been dismissed and there seems to be no intention of resuming and completing the works.

TECHNICAL ATTACHES.—Germany has for some time made it a regular practice to keep at her embassies and legations, regularly appointed technical attachés whose duties in the technical line are about the same as those of military attachés in their respective line. Other European countries have done the same, although the technical attaché has not been recognized generally as a diplomatic necessity. Russia now proposes to imitate other countries, and as a first step, will, according to the reports of Russian papers, soon send an Engineer as attaché to the Washington legation, whose duty will be to furnish his Government regular reports on the progress of technical matters in this country.

THROUGH COMMUNICATION FROM ASSAM TO BURMA.—The *Englishman* says that one of the wants of the time is a practicable trade route from Assam to Burma, and it is to supply this want that we look to the Hukong Valley expedition. Our frontier line now stretches from Peshawar to China without a break, and the establishment of commercial intercourse along this frontier, even to its eastern extremity, must ensue, though the through communication will doubtless be attended with difficulties. Still with an eager demand for our manufactured goods on the part of the Burmese, Singphos, Khyens, Khakoes, Murings, and Chins, once a path is found, we may be sure that merchants will not be slow to take advantage of it.

THE NEW ROMAN CATHOLIC CATHEDRAL IN PEKING.—The works at the new P'ei-t'ang Cathedral are being pushed on with astounding rapidity. Already rows upon rows of elegant and commodious buildings have been erected separated by wide spaces. The northern portion, which is allotted to the Sisters, is the nearest to completion. Their beautiful new chapel is now undergoing its internal ornamentation. The cathedral lifts its solid mass slowly from the ground, and begins to display its fine basilican proportions. It will be a worthy rival of the new college at Tientsin, and is in nearly the same stage of forwardness. The busiest and the jolliest man in China is the Abbe Favier, the Michael Angelo of Peking.

THE NIZAM'S RAILWAYS AND THEIR EXTENSION.—The Nizam's Government has under consideration a scheme for constructing six hundred miles of new railway. The proposal is that instead of the line now nearly completed from Hyderabad to Warangul being prolonged to Chanda, 160 miles to the north, it shall be diverted to the north-east, through the Central Provinces to Raipore, there to join the Nagpore-Bengal Railway. This alteration would increase the distance to 280 miles against the 160 of the intended line from Warangul to Chanda. Another part of the scheme provides for a railway, starting from Warangul and passing *via* Nandair, Julna, and Aurungabad to Nundgaum, where it would join the G. I. P. Railway, after traversing an immense stretch of the Hyderabad State.

MADRAS TO THE FORE.—The Irrigation works of the Southern Presidency continued to hold during the year 1886-87 the position which they have long maintained of being the most remunerative in India. Taken collectively these works irrigate a tract of country which is larger in area than one-fourth of the entire expanse of Scotland. They comprise works of all kinds and of all magnitudes. There are the great canals of the Godaveri which pour at times on to the Delta of that river an aggregate volume of more than 8,500 cubic feet water a second, a volume greater than the mean discharge of the Seine at Paris; and

there are the smaller reservoirs or tanks, spread wide over all districts, each irrigating by a trickling water course a comparatively insignificant area lying within a stone's throw of its banks.

AS OTHERS SEE US.—*Indo-European Correspondence* is kind enough to express itself as follows upon the progress made by this journal:—"The success of Mr. Pat Doyle, C. E.'s paper, *INDIAN ENGINEERING*, may now be looked upon as fairly encompassed; and it is the well-deserved reward of his talent and industry. 1,200 copies weekly, for a specialistic publication of that kind, is a circulation that argues a considerable skill in its management and a considerable range in its usefulness. The paper stands on that merit alone; no adventitious aid from politics or literature is sought to make it thrive; it is all engineering, but it is masterly engineered." We are greatly obliged to our contemporary for the handsome compliment he has paid us, and we shall endeavour to justify his opinion also in the future.

OBITUARY.—We much regret to have to announce the apparently unexpected death, at Lahore on the 24th February, of Rai Bahadur Kunhya Lal, M. I. C. E., late Executive Engineer, P. W. D., Punjab, and Vice-President of the Lahore Municipality. The deceased gentleman was highly respected and esteemed both by the European and Native community, and by the Government; and his death will cause a vacancy both in social and public circles which will long be felt. He was an old and faithful servant of the Crown, having served more than thirty years in the Public Works Department, and retired on pension about three or four years ago. He was equally the friend of Hindus and Mahomedans. The Punjab loses a prominent support. His remains were followed by a great mass of mourners of all creeds.

EQUITABLE COAL COMPANY.—There is every prospect, owing to the change in the management and other reforms introduced, that the business and operations of this Company will in future be conducted to greater advantage than for sometime back, and that the better results now shewn will be maintained, and in all probability improved upon. The Directors report that the Bengal-Nagpur Railway is now being proceeded with, but the route has been altered from Sitarampur to Asansol. They would have preferred the former route, but failing this they have been able to arrange with Government for special facilities by a branch line for the carriage of the coal from the pit mouth. This will do away with all cartage from the Company's Deesherghur and Chota Dhema Collieries and effect a considerable saving in cost.

FORESTRY IN LOWER BURMA.—The quantity of teak extracted during 1886-87 was 45,067 tons, as compared with 35,443 tons in the preceding year. The gross revenue of the year was Rs. 21,06,741, as compared with Rs. 19,73,859 in the previous year, and the gross expenditure Rs. 10,78,018, as compared with Rs. 11,50,953; the net revenue was thus Rs. 10,28,723, as compared with Rs. 8,22,906 in 1885-86. These figures, it may be noted, include the revenue and expenditure connected with forests in Upper Burma, which amounted to Rs. 1,08,074 and Rs. 2,188, respectively. During the first half of the year the average price of teak per log was Rs. 14-7 as compared with Rs. 15-12 in the previous year, but in the latter half, the average rose to Rs. 17-12 per log. The depression in the timber trade with Europe continued throughout the year.

ICE COMPANIES IN INDIA.—There are in Calcutta three Ice Companies—"The Bengal Ice Manufacturing Company, Ltd.," with a Capital of Rs. 5,00,000 in 5,000 shares of 100 each; "The Crystal Ice Supply Company, Ltd.," with a Capital of Rs. 2,00,000; and the "Imperial Ice Company, Ltd.," with a Capital of Rs. 3,00,000 in 3,000 shares of 100 each. In Bombay three Ice Companies—"The Bombay Ice Manufacturing Company, Ltd.," with a Capital of Rs. 1,25,000 and a further Capital of Rs. 4,52,175 in A. B. C. Preference shares; "The Deccan Ice Company, Ltd.," with a Capital of Rs. 1,17,000; and "The Kurrachee Ice Company, Ltd.," with a Capital of Rs. 1,40,000, and in Madras only one Ice Company, with a Capital of, it is believed, Rs. 1,96,000. Hence it is proposed to start another concern in Madras, where the daily consumption of ice is only 3 tons at the outside, and it is estimated that a capital of Rs. 60,000 will enable the proposed "South Indian Ice Company" to give a return of 36 per cent.!

THE WRECK OF THE "SIR JOHN LAWRENCE."—The delay of the Bengal Government to give some definite indication of the manner in which it intended to deal with the abuses which the investigation of the Court of Inquiry had brought to light, has been atoned for by the recent Government Resolution on the subject. The explanation of Mr. Bushby, the Surveyor to the Port Commissioners, as to the Rs. 1,000 which he received for advice about alterations to the vessel which he was afterwards called upon to survey in his official capacity, is pronounced in no way satisfactory, and he is ordered to refund that sum to the agents from whom he received it, with a severe reprimand thrown in: and the Port Officer, Mr. Duff Bruce, will have to explain, when he returns from leave, how he came to give his countenance to Mr. Bushby's proceedings. The affair, thus, is not altogether disposed of even yet.

VICTORIA DOCK, BOMBAY.—The ceremony of admitting the water into the Victoria Dock was performed on the 21st February, by Lady Reay, in the presence of his Excellency the Governor and a large crowd of gentlemen interested in the trade of the port. The water was admitted through a culvert from the Prince's Dock. The process consisted of lifting a sluice by hydraulic power. Lady Reay pushed over a handle and admitted the pressure water to the machinery. This handle was fitted with a silver top, which will, we believe, be utilized as the handle of a large ivory paper-cutter, so as to form an interesting souvenir of the occasion. The Victoria Dock, which will be opened for traffic on the 3rd April next, the time for the spring tide, can accommodate from sixteen to twenty vessels. The whole of the heavy work in connection with the Victoria Dock has been accomplished in three years, a record which it is believed, has never been beaten anywhere.

EXONERATED!—The recent extravagant expenditure at the Insein Workshops, Burma State Railways, is thus explained:—As intimated in this Journal, orders were issued some fourteen months ago by the Department of Public Works to all Executive Engineers, to the effect that, whenever in future teak should be required, it must be ordered from the Bombay-Burma Trading Company and from nowhere else. It was in accordance with this order that the Locomotive Superintendent purchased 500 tons of teak timber in the log from the Company at a cost of Rs. 47,000, or Rs. 94 per ton to make up a couple of hundred goods

wagons. As we have already explained, this timber, when cut up at the Insein Workshop, cost Rs. 137 per ton; while first quality teak scantling cut to dimensions requisite for wagon building could be delivered at the workshop from Rangoon Saw Mills at Rs. 97 per ton, exclusive of saving in time and labor. In this case clearly there is a loss to Government of Rs. 20,000.

TIDAL AND LEVELLING OPERATIONS OF THE SURVEY OF INDIA.—There are some points in connection with the introduction of these operations in India that are, perhaps, not generally known. Some years ago the question was mooted in this country as to whether the sea was receding from the coast of Kathiawar or encroaching on the land. Opinions differed as to what was taking place. The Trigonometrical Survey, then under the direction of General Walker, R. E., undertook the direct solution of this problem. This, at any rate, was the main point in connection with tidal work when it was first started, and the officer selected for it was Major Baird, R. E., who went to England to learn the *modus operandi*. On his return to India, in 1873, a systematic effort was made to secure tidal observations, by means of self-registering tide-gauges, at various points along the Kathiawar coast. Since then the operations have extended westward to Aden and eastward as far as Port Blair, the Government cordially supporting the work with the object of promoting the maritime interests attached to their sea-ports.

THE UNCOVENANTED SERVICE.—At the adjourned general meeting of the Uncovenanted Civil Service Association held at Calcutta last Saturday, Mr. R. D. Buckley moved the following amendment of a resolution proposed by Mr. F. J. Rowe:—"In consideration of the fact that up to a comparatively recent date notices issued under the authority of the Government have represented the rupee as being about equal to two shillings, and in consideration of the actual serious depreciation of its value, which has led to grievous loss and even distress to officers retiring to Europe, this meeting earnestly hopes that the Government will adopt such measures as will remove the painful uncertainty which at present exists as to the amount of all future incomes by paying pensions in Europe and the Colonies in sterling at a fixed rate of exchange; and this meeting is of opinion that the rate fixed should be at two shillings to the rupee." Mr. P. Donaldson seconded the amendment, which was supported by Messrs. Wickes and Odling. The amendment, on being put to the vote, was carried by a large majority. The minority do not, however, appear to view this result with complacency.

RIVER STEAM NAVIGATION IN BURMA.—The *Rangoon Times* points to the Irrawaddy river, as a most promising field for American capitalists in a business, perhaps, no country knows more about, *viz.*, River Steam Navigation. It says: "We have here, and have had now for some 15 or 20 years, one single Company employed in the carrying trade over some 800 miles of river, the highway between a country of some five millions of people, all of whom may be said to be engaged in agriculture and trade. Within two years of the annexation of Upper Burma, the trade has so developed, that the steamers which were found sufficient for it before, together with the additions the monopolists have been making to their fleet, are utterly insufficient to carry on the work. Traders have had thousands of tons of cargo waiting for weeks and months for carriage, for which they are willing to pay the mo-

nopolists' own exorbitant rates of freight, and yet they cannot get room on the steamers for their goods. These steamers take less than a month on the voyage from this to Mandalay and back, and return to their owners after paying all expenses for coal and wages from Rs. 15,000 to Rs. 25,000 each trip."

ROYAL ENGINEER CORPS NEWS.—Colonel H. H. Jones has embarked for Malta to take up the duties of Commanding Royal Engineer and Colonel on the Staff. Lieutenant-Colonel A. J. Hepper, D. S. O., has been appointed Commanding Royal Engineer, Guernsey, and has assumed duty accordingly. Lieutenant-Colonel H. Robinson has embarked for Mauritius, to take up the duties of Commanding Royal Engineer. Lieutenant-Colonel A. C. Ward has joined at Liverpool, and assumed duty as Commanding Royal Engineer there. Ordered Abroad:—To St. Lucia—Captain R. E. Hellard. To Hongkong—Lieutenant G. M. W. Macdonogh. To India—Lieutenants B. A. James, C. H. Haycock, V. Murray, F. F. Weedon, J. M. Burn, J. H. S. Murray, J. P. Blakeway, and H. M. Partridge. Ordered Home:—From Hongkong—Lieutenant J. A. Edmonds. From Gibraltar—Lieutenant F. E. G. Skey. Arrived Home—From Egypt—Lieutenant-Colonel A. J. Hepper. The Annual General Corps Meeting will be held on Monday, the 4th of June, at 2 P.M. in the Theatre of the Royal United Service Institution, Whitehall Yard, and the Annual Corps Dinner will take place the same day at 8 P.M. at the Hotel Metropole in the Whitehall Rooms. His Royal Highness the Duke of Cambridge will take the chair.

A COMPARISON.—The *Times of India* says that the City of Stucco would be a much more appropriate name than the City of Palaces for the capital of Bengal. The magnificent river, the noble expanse of the maidan fringed in the background by lofty buildings, is a very grand and impressive sight. But the lofty buildings will not bear inspection. They are built of brick painted with a somewhat depressing colour. The native town lacks the life and colour and picturesque appearance of the native town of Bombay, but it surpasses even Bombay in its foul odours. The condition of the Calcutta streets would disgrace an African village. Like Bombay, Calcutta possesses a Cathedral, and until the traveller sees it he would naturally suppose our capital contained the most hideous place of Christian worship in the world. The guide book states the style of architecture of the Calcutta Cathedral is Hindu-Gothic, whatever that may mean. It is a work of supererogation to say that the building was designed by an officer who was educated to make roads and build bridges. The amateur architects of the Public Works Department have erected many pretentious and hideous piles which might be regarded as belonging to the "Hindu-Gothic" style of architecture. The Post Office at Calcutta is a really fine structure, admirably adapted to the climate, crowned by a noble dome. The High Court is the Town Hall at Ypres considerably spoilt by being transplanted; but it has this advantage over the Bombay High Court, Barristers can be heard in it, and Judges can be seen.

SINGARENI.—Our Correspondent writes:—The various exploratory and established operations of this Company are being prosecuted with activity. A staff of mineral prospectors has been organised by Mr. Hughes of the Geological Survey, whose investigations will be limited, for the time the concession runs, to the Nizam's Dominions. Running surveys of several large districts have been made, samples selected and reduced, the assays of which

give favorable results at several places. Amongst the party is an expert in tin, a branch of mineralogy it was considered ought not to be ignored. Mr. E. Stephenson, who has had great experience in Madras and other auriferous localities, is Prospecting Superintendent under Mr. Hughes. The commencement of operations at the Diamond field is of too recent a date to admit of a report. At the Coal-field, operations are being energetically forwarded. As an instance of good work, the Sirdar incline has been driven 104 feet in 20 days. Of this, over 30 feet was sandstone. This ratio of progress has probably no parallel record in Indian mining. Experimental borings, to determine accurately the outcrop line, are being continued and Pits or Inclines located in favorable positions. It is a peculiarity of the outcrop of the Singareni Coal-field, that it has been washed away at some remote period, and again subjected to submarine or deltaic deposits. The depth and indefinite outline of the coal, therefore, renders extension somewhat tedious; as a shaft might be put down on an apparently certain line of strike from another shaft, and find no coal. The land also is covered with dense jungle which again adds to the difficulty of initial effort. The coal continues to improve with the depth and some really good coal is being raised from the deep workings. No faults have been struck, but there are not lacking evidences of a faulty character.

PUBLIC WORKS IN THE BOMBAY PRESIDENCY, 1886-87.—The total expenditure of the Public Works Department on Civil Works amounted to 61 lakhs of rupees during the year under review. In 1885-86 49 lakhs only were spent owing to financial pressure. Among the chief civil buildings on which money was spent the following deserve mention:—Extension works to the Central Telegraph Office at Bombay; a District Judge's Court-house at Belgaum; a new Police Magistrate's Court in Bombay; the Indo-British Institution at Bombay, and a Lunatic Asylum at Ratnagiri. Good progress was also made with the new Central Press building, and the conversion of the old town of Bijapur into head-quarters for the European station approached completion; 18 Mamlatdars' *Kacheris* and 8 Subordinate Judges' Court-houses were either in progress or were completed, and various other works were carried out. About 28½ lakhs of rupees in all were spent on civil buildings. Very nearly 30 lakhs of rupees were spent on communications. Of this sum some 11 lakhs were spent on original works. The system of connecting important local centres with the railway was extended, especially in the Southern Division. Thus about a dozen feeder roads were completed or in progress in the Belgaum, Bijapur, and Dharwar collectorates. In the Sattara collectorate three feeder roads were constructed. In the Northern Division some important roads were constructed or taken in hand, and much activity in this direction was shewn in the Thana district. Nearly half a lakh of rupees was spent on the Kurke-Belapur road in the Ahmednagar collectorate and nearly Rs. 40,000 on the Indri bridge in the Poona collectorate. This latter work approached completion. The total outlay on miscellaneous public improvements amounted to slightly over three lakhs of rupees. The clearance of the Arkilla or Inner Citadel at Bijapur approached completion. Most of the buildings within the citadel, some of which are very handsome, have been or are being converted into official residences or Government offices. The precincts of the Asar Mahal and Bolgumaz were cleared during the year and a road made to the former. Over Rs. 30,000 were spent on these works during the year.

Current News.

THE lightning at Kampti two weeks ago is reported to have killed three persons.

THE Bolan Railway has been breached in several places by floods, and will be blocked for five or six days.

MR. B. RIBBENTROP, Inspector-General of Forests, returns to Calcutta from his second tour in Upper India early next month.

IT is intended to lay a telegraph line forthwith from Darjiling to Kalimpong. A light field wire may also be laid onwards to the Rilli River.

AN order for 12,000 tons of steel rails for the East Indian Railway has gone home, and will, it is expected, be placed on board at about £4 per ton.

THE British North Borneo Company has, through the India Office, asked the Government of India to permit the emigration of Indian laborers to Borneo.

THE 32nd Pioneers have reached the Rilli River, where they will proceed to build the bridge forthwith. They have already put the road up the Teesta Valley in thoroughly good order.

THE Patna Division of the Bengal Public Works Department will be abolished from the 1st of April next, and the works of the Division will be distributed to the sister divisions adjoining it.

THE light of the Madras Lighthouse, which has been extinguished for repairs since the 7th February, will be re-exhibited from the 1st of March without any change in character or power.

MR MANSON, the Engineer deputed by Government for the purpose of framing a complete drainage and a water-supply scheme for the town of Negapatam, has completed his preliminary survey and level-taking.

THERE has been a considerable reduction made in the Government Gun Carriage Factory at Fatehgarh, on the ground that there is no work, and where there were formerly 1,000 employes there are now only about 500.

A BEGINNING has been made of the work of removing the rocky projection in the harbour of Karachi known as Deep Water Point. This will have the effect of considerably widening the channel, and will give room for additional moorings.

CAPTAINS MASON AND WAHAB, of the Royal Engineers, with three or four native Surveyors, are making a trip up the Gomal Pass, which they entered last Tuesday. They are under a tribal escort, and will proceed about 50 miles inland.

RAILWAY materials for the extensions on the North-Western Railway are fast coming in. Within the past fortnight three vessels, the *Guildford*, the *Dragoman*, and another have brought large supplies of rail and other railway stock to Karachi.

MR. J. ELIOT, the Officiating Meteorological Reporter to the Government of India, is now on an inspection visit to the Madras Presidency. It is probable that some important changes may be carried out in the Department from the beginning of the coming financial year.

SOME interesting experiments are now being made at the Presidency Division P. W. Office, Madras, as to the length of time chunam plaster for ceilings may safely be calculated to last, as, at present, the tendency of the plaster, after a short time, is to peel off and fall down.

DURING the *kharif* season, 1887, an area of 650,597 acres was irrigated in the N.-W. P. and Oudh, an increase of 60,689 acres compared with the previous year, or 10.20 per cent. The assessment on account of occupier's rate amounted to Rs. 19,95,753, against Rs. 17,57,488, in 1886, an increase of Rs. 2,38,265, or 13.15 per cent.

MR BARRINGTON BROWN, the Geologist sent out by the Secretary of State for India to report on the Ruby Mines in Upper Burma, is to be, we believe, very liberally remunerated for his services. He is to receive a salary of £200 per mensem during his engagement, which is at present for six months, and to have all his *bonâ fide* travelling expenses paid by the Government.

A PROPOSAL, which was a short time ago under the consideration of Government, having for its object the training of military officers and soldiers in Survey work, so as to have a reserve ready, in addition to the staff of the Imperial Survey Department, in connection with military operations or trans-frontier expeditions, has had to be abandoned for the present for want of funds.

TWELVE probationers are to be selected for the Indian Forest Department during 1888. An examination for this purpose will be held in England, and applicants desirous of serving in that Department must shew medical fitness and moral character. They

must be British born subjects, over 17 years of age, but not over 21. An entrance fee of £4 is to be levied from each applicant.

ANOTHER change, it is reported, is soon to take place in the office of the Consulting Engineer's Department, Madras. Major Cooper, R.E., is expected shortly to return to take up his substantive appointment, while there will be a new Junior Deputy. Of the present two Deputies, one, it is understood, goes on furlough, while another is to be transferred to the Southern Mahratta Railway.

SIR CHARLES ELLIOT has left Calcutta for tour in Orissa. He goes by the Coast Canal and up the Irrigation Canal as far as Cuttack. His object is to see the character of the Canal and country, together with the system of irrigation; and especially to judge for himself as to the carrying capacity of the Coast Canal, and how far Government may trust to it, as a high road of relief, in case of local famine.

Those who are working at Home for Karachi and its much-needed Railway extension will be reinforced in a month or two by an eminent Engineer from India, who has gone thoroughly into the matter and is full of the enthusiasm of conviction in favor of the future Punjab port. Meanwhile, the libelled "Desert," through which the railway is to pass, will be explored laterally a good deal, and some suggested alternative lines inspected.

DURING the year 1886-87 works costing from Rs. 100 to Rs. 5,000 each, and aggregating in all Rs. 47,000 in value, were constructed in the Punjab by private individuals at their own expense, for the use of the public generally. The works consisted of gardens, wells, rest-houses, tanks, bridges and roads, all designed for the most part for the comfort of the traveller, that he may rest, take his ease, and refresh both body and mind after his trudge on the dusty highways and by-ways of the Punjab.

THE Madras Harbor Trust Board, in reply to their appeal to Government protesting against the high rate at present charged by the South Indian Railway Company for the conveyance of material for the Harbor Works, have been informed that considering the large capital outlay that has been incurred in the re-alignment of the extension from the Egmore Station to the Beach, and in the construction of 100 iron wagons for the harbor traffic, the rate at present charged for the conveyance of stone from the Pallavaram quarries to the Beach, viz., 1 anna per ton per mile, is nothing but fair and reasonable.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.

SEEBPORE ENGINEERING COLLEGE REORGANIZATION COMMITTEE.

SIR.—The above Committee may not be aware that one of its Members has adopted the suspicious course of unofficially applying to a public body in Calcutta for endorsement, or rather approval, of his views with the obvious object of forcing them upon his confrères or, failing which, to use the opinion sought as a means for an end—whether in the present or future! I consider the course adopted by this Member of the "Committee" not only irregular but disloyal, as implying a desire to obtain undue advantage, and therefore agree with you that mystery in the proceedings is a mistake.

ANTI-HUMBUG.

MARRYATT'S SPECIFICATIONS.

SIR.—I have read Mr. D. B. Rabodina's remarks on the subject of your review on Marryatt's Specifications, with astonishment and amusement.

Here is another flagrant instance of a person having the assurance to actually pose as an authority and critic in the pages of a professional journal on a subject of which he proves himself to be absolutely ignorant. I will answer every assertion, made by Mr. Rabodina in detail, which can only be done by flat contradiction.

1st.—The diagrams of iron roof framing are not copied from Timmins' book as a reference to the two works will show, and the calculations are made for tile roofs not slate.

2nd.—The method used by Mr. Timmins is not the "old and inaccurate" but the new graphical. What does our critic mean by the "old and inaccurate" method? Probably he does not know himself. The analytical is the old method, but it is by no means "inaccurate."

3rd.—The details given in both books are not "defective and objectionable" as Mr. Rabodina coolly asserts, they are taken from examples of roofs which may be seen by thousands in Europe. The mention about the lines of action not meeting in a point is simply nonsense. I presume he refers to the detail of the strut connections with the tie and king rods. This is a very common method of connection and there is nothing wrong about it; the lines of action if produced an inch or so will meet in a point right enough.

4th.—Our critic after hitherto blundering at every step now concludes by a reflection on the compilers of "Marryatt's Specification" which is as untrue as it is unjust.

W. G. BLIGH.

[We furnish a review of Timmins' volumes elsewhere.—Ed., I. E.]

THE SILK INDUSTRY OF INDIA.

SIR.—Time was when the manufacture of silk was a flourishing and redoubtable Indian industry. There are still a few silk filatures in Bengal, small parcels of tusser and bufta are still obtainable in the Bhaugulpore district; but broadly speaking Bengal's silk spinning fame may be said to have gone the same way to Limbo as those marvellous Dacca muslins 18 yards of which could be passed through the inner circumference of a lady's ring with ease. It is satisfactory to find Madras essaying a revival of the silk industry, to hear that the Madras Board of Revenue conceives the time to have come for making systematic arrangements with a view to the collection and rearing of silk worms. But the Board most unsystematically suggests that these systematic arrangements might be arranged for and superintended by the Forest Department. As if Forest officers had not already enough to do without taking on their shoulders supervision of a new industry—or rather resuscitation of a dead one—decidedly the more difficult task of the two! If the work is to be properly done, done to any advantage, a special officer should be deputed to look after it, if the Etcetera Department cannot spare the necessary time. If a special officer is out of the question why could not district officers on tour this cold weather start the industry? Or Local Self-Government Boards? There are lots of people whose voluminous spare time might be occupied in the promotion of silk culture, with advantage alike to themselves and the State, and our wives and daughters. The silk fabrics their dressmakers import from France and England seem only made to wear out fast.

TUSSER.

[It may not be known that a well known expert in such matters, belonging to the P. W. D. Bengal, now on furlough, offered to place his knowledge and experience at the disposal of the Madras Government to advise it as to the best course to adopt towards reviving the silk industry in Southern India if only his actual travelling expenses were defrayed, and that this offer was declined as being—too expensive!—Ed., I. E.]

PANDRY MUTTI.

SIR.—Have your readers ever been perplexed, as I have been, in their efforts to build walls of sun-dried bricks or puddled clay (*souda*) that will not melt away in the first rainy season? In parts of Kandeish, Malina, and in the Central Provinces, mud walls may be seen, built by natives of the country, that have stood for scores of years, without protection of any sort from the weather; and yet call a native in now, and he either cannot build an enduring mud wall, or he thinks it wouldn't be good for his trade to do so, and won't do it. He will call the specimen of old wall you point to, "*pandry mutti*," in a tone implying that that kind of mud building is a lost art. Question *zemindars* and *kisans* and they either cannot or will not tell you the preparation the earth is put through to be able to resist the action of the weather. A friendly *patel*, near whose village I frequently shot small game, told me the preparation was simple enough, and described it as follows:—

Take of any white or yellow clay and make a lump on the ground 6 *hath* by 6 *hath* by 1 *hath*, equal in English measurement to 9 ft. x 9 ft. x 1½ ft. On this spread dry chopped straw a span high (6 to 9 inches), water, and have trodden out by buffaloes for 2 or 3 hours. In a *gharra* (about 2 gallons) of water steep a couple of seers of *bael* pulp, or if this is not procurable, one seer of *gunn*. After 24 hours, work into mucilage, and put over the clay puddled on the previous day. Cut up, mix and again have trodden out by buffaloes for 2 or 3 hours. Steep half a seer of linseed flour or meal in a *gharra* of water, and leave till next day. On the third day mix this with the puddled clay, and have it again trodden out by cattle. On the fourth day mix 3 seers of chopped hemp with the puddled clay, sprinkle with a sufficiency of plain water, and have trodden out by buffaloes. On the fifth and sixth days, cut up, sprinkle very slightly with water, and have trodden out by buffaloes. On the seventh day, cut up, puddle (which should be stiff), and have trodden by coolies for a couple of hours and then carried to the work. The quantity of puddle will build a wall 20 *hath* long x 1½ *hath* wide x 1 *hath* high equal in English measure to 30' x 2½' x 1½'. The cost of this quantity of finished work, my friend the *patel* said, was Rs. 6 and added "but it will cost you much more."

Will some of your readers try this and report results in your paper?

X.

THE SANITATION OF BOMBAY.

SIR.—Bombay is beginning to be exercised about the future disposal of the city sweepings, all the available land on the Byculla flats being almost used up, and purchase of more being an investment too costly to be regarded with equanimity. Nevertheless it is clear that something must be done, and that it behoves the city Municipality to come to a decision quickly as to what is to be the nature of that something, since every day of the year whether under sweltering sun or malarial monsoon rainfall some two thou-

sand cartloads of road sweepings have to be disposed of—haply with avoidance of injury to the health of Bombay citizens. For the last six months, attempt has been made to burn these sweepings in a "Beehive" destructor; but without much ground for rejoicement at success. The experiment indeed seems only to have shown that a process suitable enough for burning the contents of London dustbins—cinders and ashes for the most part that is to say—is not suited to combustion of the damp vegetable refuse it is called upon to deal with in Bombay. Moreover, the destructor can only burn some 60 or 70 cartloads of refuse a day, even when working at its best. What is that out of a total of 2,000? The Municipal Commissioner in charge of the destructor experiments recommends that they should be continued for another year, to see whether the machine's process of burning can in any wise be made to answer; but he evidently hopes against expectation, being very doubtful whether it will be possible to burn *kutchra* during the monsoon. Whereat the *Bombay Gazette* waxes sarcastic, and suggests that the doubt "is as legitimate as would be that which might arise if it were a question of burning the mud at the bottom of a river, while the water was still flowing over it!" Your contemporary thinks that Mr. Charles can scarcely be in earnest in suggesting that during the monsoon the *kutchra* might be stacked, to await the dry season when it could be burnt. For, where could it be stacked? Only at Coorla. And if the cost of that expensive transport is once undertaken, the stuff might as well remain at Coorla, and reclaim the barren soil there. This was the plan resorted to in past years, and the city is in receipt now of Rs. 200 an acre as rent for the land that was thus reclaimed. Not a bad investment it is inferred. In short, Coorla is your contemporary's way out of the municipal difficulty: Coorla and utilization of tramways and the Railway for conveyance of town sweepings to a sanitariously safe distance from the town. In time the land thus manured would come to be worth 200 rupees an acre, like the land reclaimed years ago. That is something better to look forward to than the impracticability of burning moistness on the flats. Cheaper as well as better. For, says the *Gazette*:—"The cost of burning, even if reduced to a minimum, would entail an outlay of over a lakh of rupees beyond the cost of collecting and carriage hitherto incurred." Eight annas and a half a cartload is the cost of carriage: the cost of collection must, it seems to me, be incurred in any case. Would not a light portable tramway be better than carts, and cheaper, and do much towards doing away with the difficulty? Such an investment, judiciously made, need never prove a "White Elephant." Contrariwise, as Tweedledee would say.

PUBLIC HEALTH.

Literary Notices.

I. RIVETTED GIRDERS AND CURVED ROOFS. By Thos. Timmins. Published by the author. 1882.

II. EXAMPLES OF IRON ROOFS. ditto 2nd edition. 1884.

At first glance these books give a very favourable impression. The get up is extremely good. There is very little letter press and that only explanatory of the plates which form the bulk of the volume. We cannot do better than quote the author's own words in the preface to Vol. I. He says "The chief feature of the present work is an entire exclusion of all calculations, substituting for them such easy and simple figures as the parabola, triangle and polygon for ascertaining the strains and distributing the metal in girder roofs and any framed structures having simple reaction." In short he employs graphic statics. The subject of rivetted girders is first taken up and we are given on plate I a table of figures relating to girders with every variation of span and depth from 10 to 80 feet and from 12 to 84 inches respectively. In connection with this table are 6 plates containing sections of rivetted girders with the area of bottom flange marked in plain figures over each figure. The procedure is this: the span and depth being assumed, the corresponding tabular number has to be multiplied by the distributed load in tons, giving as result the required sectional area of bottom flange.

All this is so much waste paper. The calculations for the area of bottom flange in girders is so simple, that the use of tables is quite unnecessary. The author gives no information as to details, proper proportion of depth to span, pitch and dimensions of rivets, etc., and the absurd table is liable to mislead a tyro, as he can find in it such monstrous proportions of depth to span as $\frac{1}{16}$. Six large folding plates next follow, containing diagrams of strains on trusses and plate girders, under various conditions of loading. This, though rather elementary, would be useful were constructional detail more considered. The pitch of rivets is again left out altogether, and the question of stress on the pins is not touched upon, though

their dimensions are given. Next curved roofs are taken up. One plate is devoted to corrugated iron curved roofs,—from 20 to 40 feet span. The design for the 40 feet span which is absolutely untrussed, is distinctly dangerous. Details are given, but the important point of ventilators at crown is scarcely touched upon.

The next two plates consist of various designs for curved trussed roofs, the stress diagrams for uniform and unequal loading being both given, in a very complete manner for each case. This is all very well, but it is most disappointing to find, that practical details of the iron work are, except in one solitary case, entirely omitted. Two more large plates with details of various connections of girders and rivetting are given. The conception of this work is good, and were it only properly worked out, it would be a most useful reference for Engineers in India who have a great deal to do with roofs, and iron roofs are now being more and more used. We do not want all the calculations worked out, but what we do require are details of iron work. The diagrams, if given in a small scale only, would be useful to refresh one's memory of the graphic system of calculations. Taken as a whole this volume cannot be said to be worth much—in its present form.

The next volume—II.—consists of nothing but 4 very large plates containing designs, diagrams and details for trussed triangular roofs of every conceivable span and arrangement of parts. Full details seem to be given everywhere and we consider this volume will be very useful indeed to the profession. It is not now obtainable anywhere in India, we believe, and we suggest that some of our leading bookselling firms get some out. The price is moderate, being only 12s. 6d.

New Books and Reprints.

ELECTRICITY AND MAGNETISM.

BOWICK (J.) London University Matriculation Magnetism and Electricity: With numerous Exercises and Solutions. (Stewart's Educational Series) 12mo, pp. 128 Stewart ... 2/6
SALOMON'S (Sir David) Management of Accumulators and Private Electric Light Installations, 3rd ed., revised and enlarged. Post 8vo, pp. 144. Whittaker ... 31

ANNOUNCEMENT.

By MESSRS. LONGMANS, GREEN & CO.:—
A Course of Lectures on Electricity. By George Forbes. Cr. 8vo.
ENGINEERING AND MECHANICS.

BROWN (Alex.) Practical Treatise on the Construction of the Power Loom and the Art of Weaving. 5th ed., revised. 12mo, pp. 152. Mathew. (Dundee). Simpkin. ... 3/6
LOCKWOOD'S Dictionary of Terms used in the Practice of Mechanical Engineering. Embracing those Current in the Drawing Office, Pattern Shop, Foundry, Fitting, Turning, Smiths' and Boilers' Shops, &c. Comprising upwards of Six Thousand Definitions. Edit. by a Foreman Pattern Maker. Post 8vo, pp. 420. Crosby Lockwood ... 7/6
MANT (J. B.) Pocket Book of Mensuration and Gauging, &c., for Revenue Officers, Brewers, Spirit Merchants, &c., 32mo, pp. 270. Crosby Lockwood ... 4
KICK (F.) Flour Manufacture: A Treatise on Milling Science and Practice. Translated from the 2nd enlarged and revised ed. with Supplement, by H. H. P. Powles. Illust. with 24 Plates and 113 Woodcuts. Roy. 8vo, pp. 344. Crosby Lockwood ... 25/
SLATER (J. W.) Sewage Treatment, Purification and Utilisation. A Practical Manual for the use of Corporations, Local Boards, Medical Officers of Health, Inspectors of Nuisances, Chemists, Manufacturers, Riparian Owners, Engineers and Ratepayers. Post 8vo, pp. 278. Whittaker ... 6/
WILSON (Robert) Boiler and Factory Chimneys 2nd ed. Post 8vo, pp. 64. Crosby Lockwood ... 3/6

ANNOUNCEMENT.

By Messrs. LONGMANS, GREEN & CO.:—
The Testing of Materials of Construction. By William Cawthorne Unwin.

TRADE, COMMERCE, MANUFACTURES

CROSS (C. F.) and Bevan (E. J.) A Text-Book of Paper Making. Post 8vo, pp. 254. Spon. ... 12/6
PHOTOGRAPHY Simplified: A Practical Treatise for the Use of Amateurs or Professionals 3rd ed., considerably revised and enlarged, Post 8vo, pp. 164. Manson and Swan ed., ... 6d.; 9d.
SOUTHWARD (John) Practical Printing: A Handbook of the Art of Typography, 3rd ed., with an Appendix on Book-keeping for Printers, by Arthur Powell, 2 vols. Cr. 8vo, pp. 715. Powell and Son.
TAYLOR (F. C.) The Commercial Correspondent: An Introduction to Correspondence on Business Subjects: With Exercises in Invoice Making, &c. and an Appendix Containing Explanations and Illustrations of Mercantile Forms and Transactions for Schools and Private Students. 18mo, pp. 40. Arrowsmith (Bristol). Simpkin. ... 1/6
WICKS (Mark) Organ Building for Amateurs: A Practical Guide for Home Workers; Containing Specifications, Designs and Full Instructions for Making Every Portion of the Instrument. With over 200 Illusts. and Explanatory Diagrams. Post 8vo, pp. 276 Ward and Lock ... 63/

General Articles.

MILITARY ACCOUNTS OFFICE, CALCUTTA.

THIS building is erected on a plot of ground $580\frac{1}{2}$ feet in length and $104\frac{1}{2}$ feet in width, which occupies the whole length of the south side of Koila Ghat Street, between Bankshall Street on the east and the Strand Road on the west. The site is fully occupied by the building, there being only space for a 12 feet carriage-way and the usual out-offices at the rear or south side of the enclosure. The wings at the east and west ends are appropriated to officers' rooms, of which there are four in each storey of each wing, or 24 rooms in all. Their size is 30 feet long by 19 feet wide. There is a private stair to each wing, and a small lavatory for every group of four officers' rooms.

The main body of the building in Koila Ghat Street between the wings is sub-divided on all three floors into five large wards or rooms, one measuring $67\frac{1}{2}$ feet by 47 feet, and four 84 feet by 41 feet, divided down the centre by iron columns. These are approached by two main stairs which give access to verandahs along the south side, into which all the rooms open. There are thus three central wards and two flanking wards contiguous to the officers' rooms, the halls between them being occupied by the main stairs.

The building affords accommodation for the Commissariat and Pay Offices, the Controller of Military Accounts, the Examiner of Commissariat Accounts, the Inspector-General of Ordnance, the Pay Examiner, the Examiner of Marine Accounts, the Examiner of Ordnance and Clothing Accounts, the Examiner of Fund Accounts, the Examiner of Medical Accounts, the Officer in charge of the Commissariat Central Accounts, and their office establishments. The design originally contemplated the provision of accommodation for 16 officers, 8 probationers, 4 superintendents, and 620 clerks, with some extra unallotted space to admit of the expansion or re-arrangement of the several offices, hereafter. A portion of this space has since been appropriated for the Commissariat Central Account Office. The 15 large wards, 3 of which have been allotted for the accommodation of the records and 12 for clerks, contain an aggregate of 51,145 superficial feet of floor space, and the 24 officers' rooms have a total area of 13,872 square feet. The whole building, including verandahs, stair-cases, walls, &c., covers 42,519 superficial feet at the plinth level.

The north and south facades are each 580 feet 5 inches in length, the face lines and skylines of which have been broken up at intervals by projecting the end wings, the large central wards, and the stair-case rooms beyond the general face of the building. Additional emphasis has been given in the centre by making the upper central ward 10 feet higher than the other large halls on the same floor. The height from the ground to the main cornice of the central wards is 68 feet, and that of the remainder of the building 58 feet exclusive of the parapets, pediments, finials, cupolas, &c., which surmount the main cornices.

The upper floors and roofs are built with iron beams throughout, with brick arches turned between them. The whole of the ground floor is laid with stone, and all the office rooms on the two upper floors have been finished with Portland cement plaster over concrete, and the first and second floor verandahs and passages are laid with English encaustic tiles. At the plinth level is a perforated terra-cotta damp-proof and ventilating course. The walls are built in plain brick-work, enriched with cornices of terra-cotta and other architectural decorations in the same material.

The works were carried out by the Local Officers of the Bengal Public Works Department, Mr. C. A. Mills being the Executive Engineer in charge, assisted by Mr. W. Banks Gwyther. The designs were prepared by Mr. E. J. Martin, M. L. C. E., F. R. I. B. A., the Architect to the Government of Bengal.

PERCOLATION WELLS IN THE BADAON DISTRICT, N. W. P.

A NUMBER of wells have lately been constructed by Government in the Bilsī zemindari, on the pattern recommended by Mr. J. Wilson, Executive Engineer, who was in charge of the well-sinking operations in the Awa Estate and elsewhere, under the Department of Agriculture and Commerce. The conditions of subsoil obtainable in the Badaon District are peculiarly favourable for testing the efficacy of this system. Spring level is found at a depth of seldom more than 15 feet beneath the surface, and below this a stratum of water bearing sand occurs, the thickness of which precludes the possibility of sinking a shaft right through it, except at a prohibitive cost. Hundreds of *pucka* wells are to be found in the district, that have been abandoned owing to sand having filled them up, but there are others constructed, (from economical reasons) of dry brick work without mortar, which have been successful; the supply in these cases being given as in Mr. Wilson's wells mostly through the steining, and not entirely from the bottom.

The wells in the Bilsī zemindari are made of 14 inch segmental bricks, and are generally of 6 feet internal diameter, so as to admit of two '*charsas*,' or leather bags, being worked simultaneously. As a rule a 40 feet shaft has been found sufficient in depth, 25 feet of which is below the top of the water bearing sand stratum. The lowest 5 feet of the steining, just above the wooden curb, is built of *pucca* masonry, and above this point, the shaft is constructed of alternate rings of about 4 courses each, of bricks laid dry and in lime mortar. To strengthen the shaft, a few bricks are laid in mortar in a vertical line through the dry courses at two opposite points in the shaft.

In sinking the well, *chattai* (that is matting made of date palm leaves) is wrapped round the steining and kept in position by upright bamboos, tied on with string. This is to prevent the dry courses from being displaced during sinking, and the vertical bamboos further tend to bind the whole structure together. With but a single brick steining, very careful sinking is obviously necessary, as there is great danger of the shaft being irretrievably damaged should it get much out of the vertical during the operation. As soon as the shaft is sunk to 25 feet below spring level, a plug of kunkur ballast 5 feet deep is deposited at the bottom. This effectually prevents the sand being drawn up from below the curb, but permits of the percolation of water thorough the ballast, as well as through the sides of the well. Mr. Wilson recommended, in some instances, that the plug be made of concrete, so as to be impermeable; but it is doubtful whether a sufficient supply could be obtained, wholly through the steining, unless this were made of dry brick-work throughout. Cases have occurred, in which silting up has taken place, in spite of the ballast plug, and the well has had to be dredged out and sunk to a further depth. In a few instances, all precautions against silting up have been in vain. This is probably owing to some accident having happened to the shaft in sinking. Cement concrete plugs will be tried in those cases, where the ballast has failed to keep down the sand. In the Bilsī Indigo Factory compound, a notable instance of the complete success of percolation wells can be seen. The sand substratum here was of such a depth that it was impossible to carry a shaft right through it down to the *mota* or clay deposit, and was also of very bad quality, quicksand in fact, termed by the natives *ufna*. Many wells of the usual type had been constructed at great expense, but all had to be abandoned, owing to the impossibility of preventing the sand rising in the shaft, and the factory for several years was entirely dependent on a tank for water-supply. Three years ago a percolation well on the system described, with a ballast plug, was constructed, and ever since, an apparently inexhaustible supply of clean clear water has been obtained from it. The use of any well for purposes of indigo manufacture subjects it to a severe test,

as infinitely more water is withdrawn daily than can ever be the case when worked for irrigation.

It should however be borne in mind, that this is done during the rainy season, when the spring level is abnormally high and consequently favourable to the percolation system.

CAMPBELL HAMILTON,

Manager Bilsi Zemindari and Indigo Concern.

THE MANUFACTURE OF IRON AND STEEL IN INDIA.

II.

NOTWITHSTANDING the simplicity of their processes, the iron turned out by the natives is of superior quality and is selling very cheaply; so, for instance, a maund of horse-shoes sells at Rs. 7, and of clamp iron Rs. 6-8. These low prices are accounted for by cheap fuel, the rich ores, the miserably cheap labor, and the absence of managing expenses.

There are reasons to believe that "Wootz" (Indian cast steel) has been exported to Asia Minor more than 2,000 years ago; how long, however, its manufacture has been commenced cannot be traced.

The following is a description of the method for making "Wootz" employed by the natives at Hyderabad.

The minute grains or scales of iron are diffused in a sandstone like gneiss or mica schist, passing into a horn-blende slate. These rocks are excavated with crowbars and then crushed between stones; if hard, this is done after preliminary roasting.

The ore is then separated from the powdered rock by washing. This was at a village called Dundurti, but the process of manufacture was the same as that at Kona Samundrum, 12 miles south of the Godavari and 25 from Nirmal, which has been described by Dr. Voysey. The furnace was made of a refractory clay, derived from decomposed granite, and the crucibles are made of the same, ground to a powder together with fragments of old furnace and broken crucibles kneaded up with rice chaff and oil. He states that no charcoal was put into the crucible, but some fragments of old glass slag were. A perforation was made in the luted cover. Two kinds of iron, one from Mirtapalli and the other from Kondapore were used in the manufacture of the steel. The former was made from magnetic sand, and the latter from an ore found in the iron clay (? laterite) 20 miles distant; the proportions used of each were 3 to 2.

This mixture being put into the crucible in small pieces the fire was kept up at a very high heat for 24 hours by means of four bellows and was then allowed to cool down. Cakes of steel of great hardness, and weighing on the average 1½ lb., were taken from each crucible. They were then covered with clay and annealed in the furnace for 12 to 16 hours; then cooled and, if necessary, the annealing was repeated till the requisite degree of malleability had been obtained. The Telinga name for this steel was "Wootz" and a "Kurs" or cake of it, weighing 110 rupees, was sold on the spot for eight annas. The daily produce of a furnace was 50 seers or in value Rs. 37.

Also Mysore is a country where the manufacture of iron and steel by natives was of great importance owing to the excellent quality of its produce.

The iron was made from black sand, which the torrents, formed in the rainy season, brought down from the rocks. The furnaces in the Chin-Narayan Durga taluk were on a small scale, the charge of ore being 42½ pounds, from which about 47 per cent. of metal was obtained. Work was carried on for only four months, the smelters taking to cultivation during the remainder of the year. The stone ore was smelted in the same way as the iron sand, but the latter it is said was alone fit for manufacturing into steel. There were in this vicinity five steel forges, four in the above taluk and one at Devaraya Durga.

The furnace, of which a figure is given by Buchanan, consisted of a horizontal ash-pit and a vertical fire-place, both sunk below the level of the ground. The ash-pit was about three-fourths of a cubit in width and height, and

was connected with a refuse pit into which the ashes could be drawn. The fire-place was a circular pit, a cubit in width, which was connected with the ash-pit, being from the surface of the ground to the bottom two cubits in depth. A screen or mud-wall 5 feet high, protected the bellows-man from heat and sparks. The bellows were of the ordinary form, a conical leather sack with a ring at the top, through which the operator passed his arm.

The crucibles, made of unbaked clay, were conical in form, and of about one pint capacity. Into each a wedge of iron and three rupees' weight of the stem of the *Cassia Auriculata* and two green leaves of a species of convolvulus or *Ipomaia* were put. The mouths of the crucibles were then covered with round caps of unbaked clay, and the junctures well luted.

They were then dried near the fire and were ready for the furnace. A row of them was first laid round the sloping mouth of the furnace; within these another row was placed and the centre of the dome, so formed, was occupied by a single crucible, making fifteen in all.

The crucible opposite the bellows was then withdrawn and its place occupied by an empty one, which could be withdrawn in order to supply fuel below. The furnace, being filled with charcoal, and the crucibles covered with the same, the bellows were plied for four hours, after which the operation was completed. When the crucibles were opened the steel was found melted into a button with a sort of crystalline structure on its surface, which shewed that complete fusion had taken place. These buttons weighed about 24 rupees. There were thirteen men to each furnace, a head man to make and fill the crucibles, and four relays of three men each, one to attend the furnace and two for the bellows.

Each furnace manufactured 45 pagodas worth, or 1,800 wedges of iron, into steel. The net profit was stated to be 1,253 fanams, but into the further details as to cost it is not perhaps necessary to enter. The total production of steel in this vicinity was estimated to be 152 cwt. or about £300 worth per annum.

The principal sources of the ores were the magnetic sand found in rivers and the richer portion of the laterite.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK. XXVII.

Galvanized Corrugated Iron Roofing—20 Gauge.

Items per 100 s. ft.		No. or Quantity.	Rate.	Amount.	Total.
(1)			(3)	(4)	(5)
Labor.—					
Carpenters	No. ...	3½			
Blacksmith	" ...	2			
Coolies	" ...	8			
Sundries	" ...	.....		
Materials.—					
Gal Cor. Sheets	cwt. ...	2.08	Variable.	Do.	Do.
Wind ties, Gal.	" ...	.25			
Galvanized clips	lb. ...	6.5			
" Wind tie washers	.....	2.4			
" Sheet bolts	doz. ...	12.5			
" Pot clip	" ...	.5			
" Wind tie	" ...	.4			
" Wood screws	" ...	.7			
Lead Washers (55 to the lb)	lb. ...	2.75			
Red lead, putty, cotton, and other					
Petty Establishment		.....		sundries.	

These details are for roofs where purlins are placed under overlap of sheets. With intermediate purlins there would be an increase in quantities of bolts, washers, clips, &c.

For other gauges, the details remain the same, except that the weight of cor. iron sheeting per 100 ft. is less.

For 18 gauge the weight of cor. sheets per 100 s. ft., would be cwt. 2.76

For 22 gauge " 1.74

" 24 " " 1.45

MANDALAY TOWN EMBANKMENT.

By JAMES DONNAN, ASSISTANT ENGINEER, P. W. D.

THE Mandalay Town Embankment encloses a stretch of country of an oblong shape. Its length lying due North and South is about 8 miles in extent, its width about 4 miles.

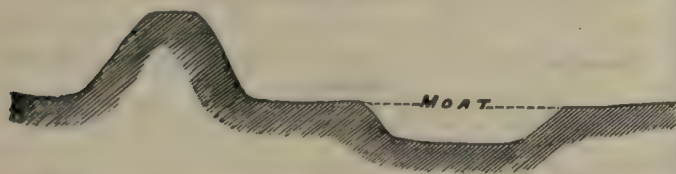
The old capital used to be Amarapura and the whole of the country north of it lying between the Irrawaddy river and the two lakes Wanda and Aungpinle, was a large paddy plain irrigated from the lakes.

On the new city of Mandalay being built the eastern portion of the embankment was constructed; leaving the west side towards the river open, and every year when the river was in flood it used to rise and inundate the country up to the line now taken by the Shwetachoung. The western portion of the embankment was built some time afterwards reclaiming a large tract of country.

It is generally supposed that the embankment was built for purely a military defence and its shape, especially on the western side, would lead one to this belief, but a further consideration would show the eastern embankment is a protection against the Lakes. The whole of the plain enclosed by it, being on a much lower level than the water in the Aungpinle Lake, and the ground gradually sloping from the Lake to the river, a breach in the Lake bund would inevitably cause a flood in the town, without the protection of an embankment to stop the flow of the water and a large moat to carry it off southward. Also on the western side an inspection of the locality will show the irregularities in the line of the embankment are mainly due to the irregularities in the level of the ground; the object being to reclaim as large an area as possible, thus causing the Burmese to take the dangerous line at the North-west corner, crossing the two beds of the Thengaze creek, and the low lying ground between these.

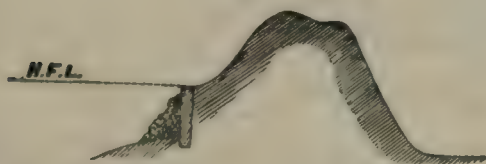
After the construction of the embankment, gates were established to admit traffic, and guards stationed at these gates as well as at other points along the bund. So that it may be concluded, that the original idea on the eastern side was protection against a flood from the lakes, and on the western side reclamation, and that the military idea was of secondary importance.

Fig 1.



The embankment varies in section in different lengths. From the Shwetachoung at the northern end eastward, along the eastern side, and again south, till it meets the Amarapura wall, the section is fairly constant, being about 10 feet wide at top, and from 8 to 12 feet high, with a large moat on the outside away from the town side. The bund being entirely of earth—fig. 1.

Fig. 2.



From the Shwetachoung at the southern end, westwards, and along the western side up to about 1,000 feet north of A road, the Embankment—fig. 2—has a brick wall at its toe on the river side with a loose stone protection in front. The top of the wall being just above the highest flood level of the water in the river. The top of the bund is high above flood level and wide, and is constructed of a military type with a bank

for protection from the fire of an enemy; both side slopes are steep.

From A road, northwards to C road, the embankment is of a considerably weaker section, being only 7 feet wide at the top with side slopes of about 2 to 1 and a loose stone rubble facing towards the river. The top of the bund is about 6 or 7 feet above the highest flood level of the river.

From C road to the north-west corner it again resumes the section shown in fig 2, and from this point along the north face till it meets the Shwetachoung the section is again weak and very nearly the same as in the length from A to C road.

The eastern embankment has always been considered safe and no special precautions were ever taken with it. Of course the bunds of the Lakes with all the sluices and waste weirs as safety valves, should be safe with ordinary care and supervision, but in case of any portion of these bunds shewing dangerous symptoms, there are two or three points along this embankment which should be strengthened. The cattle crossing it to drink at the moat have worn it down in a few places and artificial channels to convey water into the town cross the embankment in 4 places with sluices which are old and in need of repair.

The western side which has to resist the yearly flood of the Irrawaddy is the dangerous side, requiring annual repair and watchfulness, and this has 5 weak points marked on the accompanying plan by Nos. (1), (2), (3), (4), and (5), Nos. 1, 2, 3, and 4 are old stream beds which are crossed, and No. 5, is a sharp angle against which the river in flood strikes with some velocity. In addition to these, are the two sluices at the northern side where the Shwetachoung enters and at the southern side at the outlet of the Thengaya creek. These two sluices were small box culverts which were closed every year with earth, before the rise of the river, and opened out again after its fall; and were highly dangerous. I believe the P. W. D. have now constructed proper sluices.

The embankment was constructed by forced labour; various officials having certain lengths apportioned to them and all the inhabitants were called upon to either work, or supply materials; of course wealthy inhabitants were able to buy off their exemption. The earth was taken from pits outside the embankment and simply thrown up without either breaking clods, or ramming, and in some places the whole embankment is simply pure sand. I have been informed that the whole of the western portion was completed in 5 months. At the yearly floods each official was responsible for the portion constructed by him and he used to call out large numbers of the inhabitants of his quarter. Temporary camps were established on the embankment, and constant patrols costing the Government nothing. Notwithstanding all this the embankment burst during the Burmese regime at the point marked (4) on the plan and caused a flood. After the subsidence of the waters it was rebuilt over the same line, and the point at which it burst was strengthened with a loose rubble wall; and the embankment from A to C road, which was originally only about 3 feet above flood level, was raised up to its present height of about 7 feet above flood.

After the English occupation of Mandalay, a wharf embankment was formed at the end of A road by lowering the old embankment and throwing out another in front close to the water's edge against which the steamers land. This embankment was originally 20 feet wide at the top with a slope of 6 to 1 on the river face and $2\frac{1}{2}$ to 1 on the inner face. Its total length is about 2000 feet and its top 3 feet above flood level. The line taken by the embankment gives about 12 feet as the average height of the embankment. This was the first work of importance in Mandalay undertaken by the P. W. D. It was commenced in March and just finished before the first rise of the river at the end of May. The old bund behind was levelled off, and Barracks constructed on it, forming the shore Cantonment.

(To be continued.)

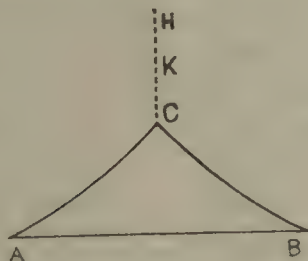
PROPERTIES OF FLUIDS.

BY A. EWBANK.

ERRATUM.

THE concluding part of Article II—last issue—has a wrong figure—

Figure 4 is



That called in print *Figure 4* should be *Figure 5*, which is given below.

III.

ACCORDING to its derivation the word fluid should mean that which flows or that which could flow like the waters down the bed of a river. We speak also of a flowing dress and here the word suggests, it may be, undulations or, it may be, rounded outlines but in any case the *absence of angles*. Frequently in mathematical books the word liquid is used where we have used fluid. In this case the term liquid is arbitrarily considered more precise than the term fluid. Fluid in fact is taken as a genus and liquid is then a species. Air is not called liquid, nor water called a gas but both are called fluids. In thus using the word fluid mathematicians have generalized the word beyond the limits that once belonged to it. The fact is that in earlier times, gases were little studied. Afterwards when some of their properties became known it was seen that in certain respects they were like to water or to other mobile bodies.

These newly discovered analogies were recognised by applying to gases a word that once was limited to liquids. These generalisations might probably, however, be found in poetry before they were formally introduced into science. Poetry and science in their highest manifestations have this in common—they are equally products of the imagination and each transcends the ordinary experience of the average human intelligence.

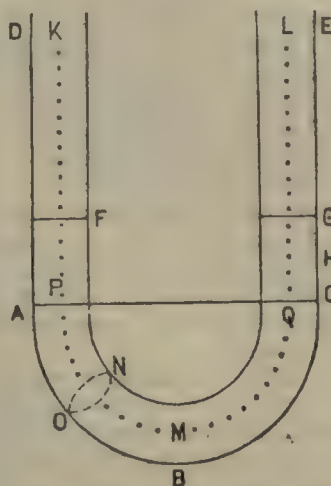
As to the characters of gases and their points of difference from liquids we may have more to say in the sequel. Meanwhile what we have been calling a fluid—and may now call either a fluid or a liquid—is a substance which we may keep in a vessel without that vessel being closed all round. The substance may indeed pass slowly out of the vessel by a process which popular speech calls “drying up” and which science calls evaporation. But if in a short space of time, say five minutes, and under ordinary temperatures say about 20°C. or 67°F., only a very small part of the liquid thus disappears—a part so small that only by extreme care could this loss be detected—we may for ordinary purposes neglect this diminution of the mass and volume.

When a substance appreciably heavy disappears at a rapid rate we call it volatile, and thus our ordinary liquids are supposed to be non-volatile. When such an ordinary liquid is contained in a vessel and does not fill the vessel there is a plane or surface on one side of which the space within the vessel is all filled with the substance. On the other side of this boundary surface there is apparently only air. This surface is sometimes called the free surface of the liquid. The other surfaces of the liquid are not free in the sense now intended. These other surfaces are shaped, not by the independent play of the molecules and by the pressure of the outside air, but only by the figure of the vessel. In the same way if one portion of a piece of india-rubber be squeezed in a vice while the rest is out in the air, that vice-held portion has

its surface shaped for it by the vice while the rest has what is called a free surface in contact with the surrounding atmosphere.

The fluidity of an ordinary heavy non-volatile liquid is a variable quantity as we pass from one liquid to another. If into a vessel we let fall a stream of water of tolerably constant breadth or section we shall see, where the stream of water meets the “free surface,” a little mountain of water something like the prominence in *fig. 4* but having its top more rounded. When the stream is ended this mountain promptly disappears. If we perform the same experiment with treacle the mountain is higher and it lasts longer after the stream has ceased to flow. The experiment thus illustrates the varying fluidity of different liquids. Another experiment may be contrived as follows.

Fig. 5.



DBE is a bent tube which may have a constant or a variable cross section. Such a tube made of glass and bent like the shape of the letter U is often called an U-tube. It is well to have the tube of glass because the movements of the water (or other liquid) can be watched through the glass. Glass vessels from their transparency are exceedingly useful in many scientific experiments. The U tube may be supported in a stand specially made—or it may be held in the hand.

Water is poured in till the free surfaces are at some one level AC. We now wish to introduce an extra portion of water such as would fill any arbitrarily chosen volume F A. Before pouring in this additional water let the orifice E be firmly closed with the finger or by any other means. Then the water F A may be added quickly or slowly. As we do so the level at C will rise but will not rise so fast as does the level at A. When the water has been added let the orifice E be suddenly opened. We shall see the water in the E branch shoot up to some height and then recede and finally, after some oscillations, settle at a new level H. If we repeat the same experiment with treacle the upward shoot of the liquid on opening the orifice will not be so quick nor will the oscillations be so pronounced.

If instead of water or treacle we had used a powder the level at C might remain unchanged by the addition of the mass F A.

Resuming the case of water being used the effects observed will vary with the dimensions of the tube. For a given cross sectional area the effects are more pronounced with long tubes because we then have long columns of water. If the length of the tube be given the section should be fairly broad. In a narrow section the water moves with difficulty. With a section sufficiently narrow, water will not move at all—that is it will not move by its own weight.

If now we consider what happens when the orifice E has suddenly been opened we see that if we take a number of normal cross sections of the water such as the section ON each corresponding layer of water will take some movement. Down the middle of the tube we have

a central core of water molecules commencing above P and ending above Q. Each of these molecules will be displaced.

If we consider a series of particles in the outside of the water columns—say the series which contains A, O, B &c. we may inquire how this set of particles moves. If a layer of water such as O N were to move bodily into the position of an adjacent normal cross section, then particles like that at N will have to move slowest, and particles like that at O will have to move quickest, these latter particles having the longest distances to travel. The central core of particles P M Q will have a sort of average velocity.

There is however no reason why the A O B particles should actually move more quickly than the central core. On the contrary there is a reason why they should move more slowly. For they are retarded by rubbing against the sides of the tube. Accordingly they actually do move less rapidly than does the central core. Between the central core and the outside particles such as AOB there are intermedial series or files of particles.

As they do not all move with such varying velocities as shall allow the O N layer of particles to move bodily forwards—retaining the character of a normal cross section—it follows that the successive layers get dislocated or broken up and so the particles must make fresh layer arrangements. In this breaking up and reforming of ranks the particles rub against each other and the frictional resistance which they offer to each other is what we will call a feature of imperfect fluidity. It is sometimes called viscosity.

If we could with great precision watch the upmost layer of particles that shoot up towards the G section we should see that the inner particles rise higher than do the outside particles, so that the free surface is momentarily more convex than it will be when the water has come to rest.

NOTES FROM HOME.

(From our own Correspondent.)

THE war to which I referred in a previous letter, continues between the Southern Railways. The Brighton Company have proposed a truce of five years during which time things shall remain as they are, neither company to attempt any variation in the present working of agreements nor advance any hostile claim outside of or inconsistent with the existing state of things, and a high authority to be appointed to award damages against the company acting contrary to the fair spirit and meaning of the agreements. The South Eastern cannot see the necessity of this truce, but the Brighton Company consider that the suggestion made is actually necessary before any project dealing with a working union between the companies can be even considered.

In a pamphlet entitled "The South-Eastern Railway: a few facts on its management under Sir E. Watkin," Mr. Abbott refers to Sir Edward's wanton action in withdrawing the Bill for the fusion of the three companies to which is attributed the loss of £2,000,000 in working expenses, an unnecessary expenditure of money in law and Parliamentary charges and a reckless and profligate issue of debenture capital involving a loss to the company of a million sterling. The *Standard*, however, in a leading article considers that to remove Sir Edward would be highly injurious to the Railway, pointing out that the movement has not originated within but without. That a fusion of the Railways, or a working union would not tend to benefit the public and that placed in the position of the South Eastern Railway a "fighting chairman" is really required. Great interest centred in the meeting of the South Eastern when desperate efforts were made to turn out the chairman. The result, however, was that he is supported by a large majority and the attempt to oust him resulted in a vote of confidence very cordially granted him. We shall now look forward with interest as to the next move in the war between these rival companies.

A very elegant, and admirably executed altar-piece or reredos has just been added to St Paul's Cathedral, and forms a very important feature in the internal arrangements of the

building. It was designed by Messrs. Bodley and Garner and is entirely executed in white Parian marble with bands and panels of Rosso Antico Verdi di Prato and Brescia marbles with gilt enrichments. The design consists of a basement with sculptured panels supporting an open colonnade semicircular in plan. Over the centre of this is a large group of sculpture, the whole being crowned by a central niche with supporting statues.

An account has been recently published of the new Magazine rifle that the Special Committee on small arms has selected as the British Magazine rifle of the future. The new weapon is described as a modification of the improved "Lee" also of the Manuliches Austrian rifle, the bolt being withdrawn by a straight and simple backward motion, and as it can be worked without taking it from the shoulder, the rapidity of fire is very great. It is said that 46 shots have been fired from the Manuliches in one minute. The magazine holds eight rounds. The bore of the new rifle is 0.303 inches a reduction upon the Martini Henri which is .45 inches. Among the advantages of this reduction is one giving a higher velocity and flatter trajectory to the bullet in flight. The trajectory of the new rifle is very flat being 2 feet 10 inches for 400 yards range and 5 feet for 500 yards range against 8 feet 6 inches the case of the Martini Henri. It is intended to use nickel instead of copper for the cartridge cases to obviate the accumulation of verdigris. The sighting of the rifle is somewhat novel and is arranged for a power up to 3,800 yards. A modification of the bayonet is also proposed. The experiments have met with success and orders have already been sent about for a considerable number to be tried by the navy, army at home and in India.

At the Annual General Meeting of the Institution of Mechanical Engineers, held this week at the Institution of Civil Engineers, the discussion on Irrigating Machinery on the Pacific Coast was resumed. This paper deals more particularly with the peculiar character of machinery required for irrigation and drainage in California, describing in detail the various kinds of centrifugal pumps in use in that country, and concluding with a consideration of hydraulic rams. A paper is also to be read on the position and prospects of Electricity as applied to Engineering by Mr. Geissel of Edinburgh; and one on the Third Report of the Search Committee on Friction: Experiments on the Friction of a collar bearing.

A new system of Electric Tramway (the Linea) has just been shown in action at the dépôt of the West Metropolitan Tramway Company at Kew, and it is stated that this Company intend to apply the system to their line between Hammersmith and Kew. The essential novelty of the system is the way the current is taken from the main conductor which is laid continuously along the line. A copper insulated conductor is laid inside an iron gas-pipe of about an inch in diameter. The current is tapped by metallic saddles about 3 feet apart and which are screwed in through the iron pipe and into contact with the copper core. The conductor is laid in an iron trough with two flanged rails placed over it, leaving an opening between them as in cable tramways. The car has an electric motor boxed in under the floor, and from a longitudinal central bar a gun metal chain bows downwards from two vertical plates which pass from the two ends of the bar between the central rails of the tramway into the trough. The contact of this chain with the saddles tapped into the conductor takes off the current which is led to the motor, and from it by the wheels to the outer rails of the tramway, thus completing the circuit. The cost of laying down the central line of trough rails is given at about £2,000 per mile.

The death is announced of Mr. Waddell the well-known contractor who was one of the largest employers of labour in the Kingdom. He was in his sixtieth year. The death is also announced of Mr. Godwin, F. R. S., the late Editor of the *Builder*.

CHINA.

(From our own Correspondent.)

THE reason why the Yellow River has a tendency to overflow the low-lying plains south of it is because the land to the north is higher than that on the south, and the water very naturally tends to gravitate to lower ground than that of its artificial bed on the north side of the delta lands. As time goes on the various rivers flowing down from the

northern elevated lands to the Yellow River bring down a tribute of silt, as well as a tribute of water, and thus constantly increase the danger of a rupture of the embankments on the south, by raising the bed of the river from the north making it more and more difficult to confine the river to its higher and most northern channel.

During the occupation of Northern China by the Kin Tartars, in the twelfth century, the banks of the river were probably neglected, and may possibly have been purposely tampered with by the Chinese Military Commanders, entrusted with the task of expelling the invaders. Finding themselves unequal to conquer their enemies by the ordinary modes of warfare, they may have had recourse to extraordinary ones, and may possibly have cut through the embankments of the river in order to drown out their conquerors.

At any rate, it is said that the river abandoned its northern channel altogether in the thirteenth century, causing frightful havoc in the plains of Ho-Nan and Kiang-Su, and whilst flooding the low-lying plains to the south, it left a large portion of the plains of Shan Tung and Chih-li Provinces, which it had formerly watered, like a barren wilderness. The consequence of all this caused great suffering throughout China, and great disorder prevailed in all the provinces north of the Yangtze, which no doubt prepared the way for the Mongolian invasion which followed.

The invaders being a hardier race than the Chinese soon overcame all resistance, and their indomitable leader, the mighty Kublai Khan, having seated himself firmly on the throne of China, soon set to work to rectify the mischievous results caused by the change in the course of the Yellow River during the occupation of Northern China by the Kin Tartars. Kublai in his days caused the banks of the river to be attended to, and cut a canal from Peking to Tung Chang Fu, in Shan Tung Province, near where the old canal connecting the Yangtze with the Yellow River terminated. When that canal was finished it not only drew off some of the surplus waters of the Yellow River, but restored fertility to the arid plains of Shan Tung and Chih-li, through which its course was led, and gave access to the invaders, by water to all parts of the Empire, and permitted of the produce of the Southern Provinces of China to be brought to Peking by water at reasonable rates.

The next great disaster caused by the doings of the Yellow River is said to have occurred during the reign of the Emperor Kien Lung of the present Dynasty, A. D. 1736-1796.

The river is said to have caused a great deal of trouble in those days, and to have taxed the abilities of the Government to their utmost extent, before the waters were brought under anything like reasonable control. The famous Tartar General or Field Marshal, Ah Kiang-Chun, was appointed to superintend its contrivance, with unlimited powers to do as he pleased or found expedient to meet the requirements of the case. Marshal Ah, on that occasion, caused the waters of the river to be diverted into two main channels. He further caused to be built a sort of net-work of dykes, as supplementary embankments to restrain the rush of water in case of rupture of the main or principal embankments taking place. His plan was no doubt a good one, but the perishable nature of the material used—millet stalks and sand—soon proved that to keep all these embankments in good order would require more money and labor than the country could afford, and they were allowed to crumble away uncared for. The land occupied by the crumbling dykes, being brought under cultivation by enterprising squatters, who having no other property were very glad to get such pieces of land, careless of the terrible consequences that might follow, as the result of their enterprising and industrious actions.

In the reign of the Emperor Hsien Feng, the whole Empire was in a great state of disorder, and the embankments of the Yellow River and Grand Canal appear to have been left to take care of themselves. In 1854 there was a rupture of the northern embankment of the Yellow River, and its course was bodily diverted in a northerly direction, so that it flowed into the Gulf of Pechili on the north of the Shan Tung Promontory, instead of on the south of it, as it had done before. A frightful lot of damage was done on that occasion, and the unsettled state of the country prevented proper attention being paid to the repairs of the embankments that held out still on the south side; consequently in 1857, or 1858, another rupture took place, this time in the southern embankment, and near the frontier of Ho-Nan, Chih-li and Shan Tung Provinces. The course of the river was not al-

together diverted on this occasion, nevertheless a considerable amount of damage was done in several fertile districts of Shan Tung Province.

In the year 1874, H. E. the late Ting Pao-Chên, who was then Governor of Shan Tung, undertook the task of repairing this breach, so as to confine all the water to its northern course, in order to reclaim the immense tracts of rich land then lying under water on the south of the Main River. At the invitation of H. E. I visited the works going on at the breach, and remained there three days, during which time I saw enough to convince me that such work would not stand, and H. E. was rather annoyed, because I was honest enough to tell him so when he asked me what I thought of what he was doing. H. E. besides conducting the ordinary affairs of his Provincial Government, also superintended the works in person and was to be found at the breach every day, as soon as he had finished reading and answering the numerous despatches that reached him daily from all quarters of the province as well as from the Central Government at Peking. All the officers, and many thousands of men, employed were all well paid and worked diligently, but their energies were not directed in a proper or scientific manner. Hence the fault. The principal materials used at all the Yellow River works are millet stalks, called *Shu Kiai*, mat bags, and sand or loam, of which the soil consists. The millet stalks are made up into immense fascines, or *sap rollers*, if such a name can be given to materials used in stopping instead of opening a breach. The fascines are fastened with good, new and stout, though flexible, hemp ropes. The sand or loam is put up in the mat bags, which when full weigh about fifty pounds. When everything is ready the fascines are rolled up to the breach, lots of men going on and holding on to them until the fascines reach the bottom of the gap; the bags of sand are then thrown in behind, and on top of the fascines to weight them down, the men getting off as soon as safe to do so, that is, when the fascines are securely fixed by pegs. Sometimes the fascines are swept away by the force of the current before they can be sunk or fastened down, especially when the breach is getting narrow.

I recommend the filling of old junks with stones for the stopping of these gaps, quickly and effectually, and then the facing of the whole of the embankments, that are above the level of the plains, with blocks of concrete, which would prove equal to what is required of them if properly made and properly laid. In fact, any kind of material imaginable is likely to be much better than that which is now used. The fascines rot and decay, in one year, or so, and the sand is washed away by the current, or blown away by the strong winds nearly always blowing on the Yellow River. The cost for the materials I recommended to be used would, of course, be much greater, than the cost of that which it has been customary to use from time immemorial. Millet stalks and sand, as well as hemp, and rush mats, are easily obtainable, whereas timber, stone, lime, and such like are scarce and costly. They are, however, the best kind of material for such work. There is also a way of preparing the soil in such a manner as to make it far better than it is without any artificial preparation, but the Chinese are always crying out against increase of first cost.

I also proposed that the river should be dredged in its entire length, deep enough to admit of its being navigated by steamers from which dues could be collected for the maintenance of the river embankments.

The dredging would cost a lot of money, but the silt taken from the bottom could be piled up against the embankments wherever the plains are below the level of the river, and thus prevent so much damage being done, as is done now, should a rupture of the embankments take place, or an overflow occur. In either case something much more substantial than the material used at present is necessary to ensure safety and long lasting of the embankments. The work is of course a gigantic one, any way we like to take it, but the interests at stake are also gigantic.

The inhabitants of the fertile plains, watered by the Yellow River, are always exposed to the great danger of being flooded out. Millions of taels are spent every year in patching up with sand the embankments that are always being washed or blown away. Stone or concrete would prove almost everlasting.

Two foreign Engineers have been sent to survey the extent of the damage done, and to report on the way they may deem best to effect a closing of the breach. Their plans will,

no doubt, be much better than Chinese ones, but they will probably be pronounced impracticable on account of the great cost, or expense, that will be indispensable to their being carried out. As soon as the native officials, who have been ordered to the place, get there, they will probably recommend the work being done in the old-fashioned way, and will promise to do it effectually for ridiculously small sums, in comparison with the amount that will be required for doing the work in accordance with the plans proposed by the foreign Engineers.

NOTES FROM TENASSERIM.

(From our own Correspondent.)

SINCE writing my last, we have been visited by the Chief Engineer, who came with the express purpose of reporting on the feasibility of a railway from Martaban to Shwaygheen. Mr. Dawson, who already possesses a tramway running from a place called Duyinzeik to Thaline, a distance of eight miles, wants Government to make over the Martaban Road to him to construct this railway, and is at present negotiating for it. His Manager, Mr. Hilbert, accompanied the Chief Engineer in his inspection, but how far things have been settled I cannot as yet tell. If the present cart road from Martaban is to be utilized for the Railway, I am afraid a good deal of work will have to be done in the matter of straightening it, as the road never being intended for a railway, has a good number of sharp curves in it. Parallel to the road and some distance from it, there is a waterway, natural in some parts and artificial in others, which is used by boats coming up from Moulmain. This, I am told, has not so many bends as the road, and if the railway could be made to take a direction near this cutting, a better alignment would be afforded, and besides the cutting could be benefited by having the earth required for the railway embankments taken from it. At present the cutting is navigable only during the rains, but if deepened boats could go through with the tide all the year round. That the railway, if ever it becomes *une fait accompli*, would rapidly pay itself, is the opinion of many of the profession, and we are all in hopes of it being taken in hand soon. Our present Chief is of ripe Burma experience, and we may be sure that if the railway is really the desideratum it is said to be, he will see it through. The only serious obstacle in the way will be the bridging of the river Sittang—i.e., if the line is to be joined on to the Toungoo one.

This is a pretty wide river and noted for its "bore," which is of some height. However, Engineering skill will soon triumph over this, and I hope to report in my next something more definite about this line. I need not say anything of the Toungoo-Mandalay Railway, for I am told that with the exception of the delay accruing from want of rails being sent out from England, work is progressing very satisfactorily there. An accident happened to a material train and one woman was killed, I believe. This was at a place near Pyinmana. The correspondent to the local paper attributes the accident to the recklessness of some one. An investigation is to be held and I shall report the result.

I am glad to state that we have had no fires last month. Writing about fires, may I ask if brickwork is in any way injured by them. I have seen some houses that had been gutted of every thing but the walls, and to all appearances these seemed sound. Could you, or any of your readers, oblige by informing me how I am to know to a certainty when such walls are injured and unsafe. Judging from their appearance one cannot tell. Is there any practical test to find out their worthlessness? An old bricklayer told me that it is always well to let such walls stand over till the rains, when the defects or weak points will soon shew; but as this can only be done when no danger to other houses is likely to accrue by their falling, I shall be much obliged if anybody would give me the information asked for above.

The Civil Surgeon of Moulmain has furnished the Municipality with a few hints on the sanitation of the town, and amongst the hints I see one about procuring good potable water for the people. I earnestly trust the Municipality will bestir themselves in the matter and construct the water-works necessary, but I am afraid it will take that august body some time to recover from the effects of a good hard blow they lately received from the Chief Commissioner regarding their administration. The Municipality of Moulmain really want an

Engineer like their late one, Mr. Addis, to have large Engineering works undertaken and done. At present they have none, and consequently have to indent on the P. W. D. for help on any great matter.

We have had some royal visitors lately. Prince Henri and Princess of Bourbon were the guests of our popular Commissioner for a few days. They left after visiting some of the famous (*sic.*) caves in our district. I wonder what impression they have taken away with them of the Burmese. Jack Burman is noted for his idleness and supineness for everything connected with this life, and if they are believed to be the laziest race in creation, few will say that they have been hardly treated. Ask a Burman to do a job for you, and be it ever so early in the morning, he will tell you "All right I'll come to-morrow," and when he does come, it will only be to bargain and intimate (if he is satisfied) that he will start the work the *day after*. An experienced officer once told me that nothing less than a famine would ever make a Burman less supine, and although this is scarcely in keeping with Christian sentiments, I do believe he is right. The reports from up-country are to the effect that dacoity is diminishing, but this was said last year also. Probably the approach of the rains is inducing many of them to seek better shelter and food than that at present afforded by the jungles.

The Cathedral and Victoria Park are in *statu quo*. Work, I believe, is to commence on the former as soon as possible, and a contractor is being looked for, the old one having failed to give satisfaction. The part of the town that was lately burnt down is rising up again. Houses are being rapidly built, it is a pity that the river view from the Lower Main Road should be spoiled by allowing houses to crop up between it and the river. This space of ground is so uneven, that permission to build or rebuild on it could easily have been refused by the Municipality on the ground of its being unfitted for such purposes. The dust in Moulmain still continues to be a nuisance, although most of the roads are watered.

The B. I. S. N. have very kindly commenced to run three mails a week from Moulmain now. From a mail once a week it came to two, and now we have three. The mails leave Moulmain every Monday, Wednesday and Friday, another steamer leaving from Rangoon the same days.

Our Horticultural show came off on the 27th of last month, and there was a fine display of vegetables and plants. It was always supposed that cauliflowers were difficult to grow in Burma, but this has been proved to be wrong. A resident of Moulmain turned out cauliflowers that surprised all, and though they were not put into the competition, were admittedly the best. The secret of success in these was due to frequent transplanting, a wrinkle worth knowing.

By-the-bye, I saw a tit-bit in your paper about a remarkable hand at whist, one of the players getting all the trumps and the others ordinary hands. A similar instance occurred at a place near Moulmain, where two gentlemen were at double dummy, one of the gentlemen had all the trumps and the other had all the spades, and on turning up the other hands the full suits of diamonds and clubs were discovered, respectively. Strange, but true; for I had it from one of the gentlemen concerned.

A word before I close. In the articles on "Mechanics" by Mr. Ewbank, may I suggest that the figures be reproduced on all the pages where they are referred to.* It is such a bother to have to turn over about half-a-dozen times to follow the reasoning. The reason that Todhunter's Euclid is more popular than other works on geometry is due to this fact, *viz.*, that the figures are reproduced on all pages where they are referred to. A little more attention also to the figures would be desirable, for many of them are blurred and indistinct. Regarding the diagrams that are attached to your paper, it is a pity your correspondents do not send in drawings of a size suitable to its pages. I fear to open them out lest I'll not be able to fold them back again to their old position. It seems like solving a puzzle to know how to do and undo them properly. Trusting you will take these hints in good part, and wishing you every success and prosperity on this the second year of your existence.

DEXTER.

MAULMAIN; }
February 10, 1888. }

* Our Correspondent is doubtless unaware of the expense and trouble this would involve.—ED., I. E.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Mysore, February 18, 1888.

Mr. F. J. McLaughlin, Executive Engineer, Ashtagram Channel Division, is granted privilege leave of absence for 2 months and 24 days from the 26th instant, or date of departure.

Mr. Govindachariu, Assistant Engineer, is appointed to officiate as Executive Engineer, Ashtagram Channel Division, during the absence of Mr. McLaughlin on leave.

Burma, February 18, 1888.

Upper Burma.

With reference to *Burma Gazette* Notification, dated the 28th January 1888, Mr. J. P. Henderson, Assistant Engineer, 1st grade, joined the Meiktila Division on the afternoon of the 24th January 1888.

With reference to *Gazette of India* Notification, dated the 14th December 1887, Mr. C. C. S. Clarke, Assistant Engineer, 1st grade, reported his arrival at Rangoon on the forenoon of the 26th December 1887, and is posted to the Meiktila Division, which he joined on the afternoon of the 10th January 1888.

Madras, February 21, 1888.

Mr. H. E. G. Evans, Executive Engineer, 4th grade, sub. *pro tem.*, is granted furlough (m.c.) for nine months from date of relief.

The following posting is ordered:—

Captain L. Langley, R.E., Executive Engineer, 2nd grade, sub. *pro tem.*, to the office of the Chief Engineer for Irrigation as a temporary measure. To join on return from furlough.

Punjab, February 23, 1888.

Mr. J. K. E. Verschovle, Assistant Engineer, 1st grade, from the Office of Superintending Engineer, Bari Doab Circle, which he left on the forenoon of the 4th February 1888, to the 1st Division, Bari Doab Canal, which he joined on the forenoon of the same day.

Bombay, February 23, 1888.

Mr. C. Subrao, B.A., L.C.E., is appointed to the Public Works Department as an Assistant Engineer, 3rd grade.

Mr. H. Ramanna, B.A., L.C.E., is appointed to the Public Works Department as an Apprentice in the Engineer Establishment on probation for one year.

Central Provinces, February 25, 1888.

Nine months' furlough is granted to Mr. J. B. Leventhorpe, Executive Engineer, with effect from such date as he may be permitted to avail himself of it.

Mr. H. L. Cleaver, Assistant Engineer, attached to the Wardha Coal State Railway, is temporarily transferred to the Katni-Umaria Section of the Bilaspur-Etawah State Railway. Mr. Cleaver made over charge of his duties at Warora on the afternoon of the 12th current, and reported his arrival at Umaria on the afternoon of the 14th idem.

N.-W. P. and Oudh, February 25, 1888.

Irrigation Branch.

Mr. J. H. William, Executive Engineer, 3rd grade, sub. *pro tem.*, Cawnpore Division, Lower Ganges Canal, is transferred to the charge of the Bhognipur Division, Lower Ganges Canal, *vice* Mr. Thornhill, Executive Engineer, granted furlough.

Mr. R. A. Cordner, Executive Engineer, 1st grade, is transferred from the Meerut to the charge of the Aligarh Division, Ganges Canal, *vice* Mr. Barron, Executive Engineer, granted furlough.

Mr. E. A. Carewell, Executive Engineer, 3rd grade, sub. *pro tem.*, is transferred from the Anupshahr Division and posted to the charge of the Meerut Division, Ganges Canal, as a temporary measure, *vice* Mr. Cordner, Executive Engineer, transferred to the Aligarh Division.

Buildings and Roads Branch.

Mr. J. W. Alexander, Executive Engineer, 1st grade, on special duty, Office of Superintending Engineer, 3rd Circle, Provincial Works, is appointed to the charge of the Lucknow Division, *vice* Mr. W. C. Wright, Executive Engineer, 1st grade, granted furlough in India for two years.

India, February 25, 1888.

The services of Mr. R. S. J. Routh, Executive Engineer, 4th grade, sub. *pro tem.*, State Railways, on his return from furlough, are placed at the disposal of the Agent and Chief Engineer, Bengal-Nagpur Railway Company.

Mr. W. C. L. Floyd, Executive Engineer, 1st grade, sub. *pro tem.*, Deputy Consulting Engineer to the Government of India for Railways, Calcutta, is granted special leave for a period of two years, under the terms of Public Works Department letter of 3rd October 1887, with effect from 1st April 1888.

Mr. J. R. Bell, Superintending Engineer, 3rd class, temporary rank, State Railways, is appointed Engineer-in-Chief of the Chenab Bridge Works at Sher Shah, under the orders of the Director of the North-Western Railway.

Mr. W. D. Barrow, Assistant Engineer, 1st grade, State Railways, is, on return from furlough, placed temporarily at the disposal of the Punjab Government for employment on the Patiala-Bhatinda Railway.

Colonel A. LeMessurier, C.I.E., R.E., Chief Engineer, 3rd class, sub. *pro tem.*, State Railways, is appointed to officiate as Consulting Engineer to the Government of India for Railways, Calcutta.

Major W. H. Coaker, R.E., Deputy Consulting Engineer for Railways, Madras, to officiate as Deputy Consulting Engineer to the Government of India for Railways, Calcutta, until further orders.

Colonel K. A. Jopp, R.E., Deputy Consulting Engineer for Railways, Madras, is appointed Deputy Consulting Engineer to the Government of India for Railways, Calcutta.

Major S. Smith, R.E., Officiating Deputy Consulting Engineer for Railways, Madras, is confirmed in that appointment.

The services of Mr. F. B. Hebbert, as Executive Engineer, 3rd grade, State Railways, are placed at the disposal of the Government of Bengal for employment in the Railway Branch.

Lala Rala Ram, Assistant Engineer, 3rd grade, State Railways, is promoted to Assistant Engineer, 2nd grade, with effect from the 1st January 1888.

Mr. T. Beatty, Executive Engineer, 1st grade, Bengal, is granted special leave for one year.

Director-General of Railways.

With reference to Public Works Department Notification, dated 17th February 1888, Lieutenant Charles Stuart Rose, R.E., Assistant Engineer, 2nd grade, is posted to the North-Western Railway.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 22nd February 1888.

116 of '87.—Neil Fox, of Shahjahanpur, in the North-West Provinces of British India.—For improvements and additions to sugar-cane crushing mills.

137 of '87.—Edward Lennon Cantwell, Civil Engineer, of the Town of Calcutta.—For improvements in roller cotton gins and improved roller cotton gins for manual, cattle, or steam power.

20 of '88.—William Dalrymple Borland, of London, England, Analytical and Consulting Chemist.—For improvements in explosive substances and absorbent materials therefor.

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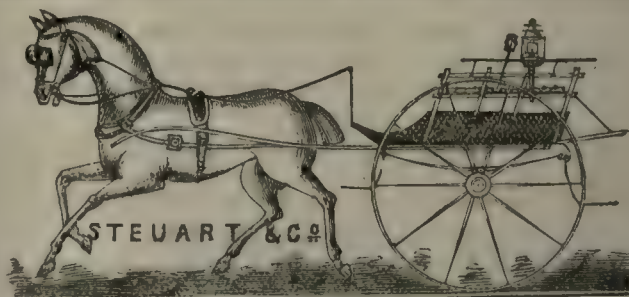
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In our next.

INDIAN ENGINEERING.

SATURDAY, MARCH 10, 1888.

RAILWAY TRAFFIC IN BENGAL.

THE Secretariat Report dealing with the rail-borne traffic of Bengal during the official year 1886-87 is a comprehensive State paper, and likely to be of more use, we take it, than a good many of the Blue Books with which Government printers are usually concerned.

It is a Report based on returns furnished by all the Bengal and Behar railways, by the Collector of Customs, Calcutta, by Divisional Commissioners, and District Officers, and deals with its subject, and all possible collaterals, so exhaustively as almost to be diffuse. As, for instance, in a statement shewing the average wholesale prices which prevailed in Bengal markets during the year under review, as compared with 1885-86. A comparison of total values of rail-borne export and import trade between the two years seems more to the point. The former shewed an increase of 1.45 per cent., the latter a decrease of 13.12 per cent. The largest falling off in imports occurred in the trade carried from the North-Western Provinces and Oudh. Small though the figures for increase of export trade appear we look upon them as most encouraging.

Western Bengal last year exported 2,19,478 maunds more of coal than in 1885-86. The improvement was due to a demand from foreign railways and mills up-country. About coal, here is an extract from the Commissioner of Burdwan's Administration Report: "The demand for coal, especially during the last six months of the year, has been very great. From the statements received from the station-masters it appears that the exports of coal from the sub-division have been 783,517 tons, against 598,794 tons in the previous year and 635,921 tons in 1884-85. The increase has been chiefly at the Sitaram-pore station, from which alone 245,652 tons have been despatched. Though I was aware of the great briskness of the coal trade, this enormous increase surprised me, and I asked the station-master of Sitaram-pore to verify his figures, when he re-asserted their correctness. Sitaram-pore is the railway station for the Alipore Coal Company and the Bonea and Belrui collieries, for the new Beerbhoom Coal Company, the Equitable Coal Company, and many native companies. The stocks of all the companies have been exhausted, and the price of coal has risen. The causes for the great increase are no doubt partly the revival of the jute trade in Calcutta, and partly the increase in the lime and brick industries in Raneegunge, but it is chiefly due to some of the steamship companies now making use, as I am informed, of Indian coal." As to metals, we are told that the quantity of unwrought copper exported from Calcutta shewed a decrease of 22,208 maunds, namely, 17,288 maunds in the despatches to the North-Western Provinces and Oudh, 4,675 maunds in those to the Punjab, and 245 maunds in those to other places. The imports of unwrought copper into Calcutta last year by sea fell off by 10 per cent., and this fact, coupled with a slackness in demand said to be due to

stocks being held at some of the manufacturing centres, led to a decline in the upward trade. The increase shewn under iron was mainly due to the increase in the quantities exported from Calcutta to the North-Western Provinces and Oudh (18,450 maunds), and to the Punjab (31,909 maunds). The increase occurred chiefly in scrap iron, machinery for mills, &c. In "other metals" the consignments to the North-Western Provinces and Oudh from Calcutta decreased from 88,100 maunds to 54,742 maunds.

The extended use of kerosine oil and the reduction in railway charges led to an increase in the quantity sent from Calcutta to the North-Western Provinces and Oudh, the exports amounting to 77,245 maunds, against 57,756 maunds in 1885-86.

A large decrease in the export of railway plant and rolling-stock is accounted for as being due to diminished supplies carried to Sindh and the Central Provinces. To the completion of local railway lines, that is to say. No matter for regret, therefore, imperially considered.

For most of us the most interesting part of this review will be the chapter relating to the traffic along the State Railways that are in their infancy, and on trial. In that connection it is satisfactory to find that the aggregate traffic carried by these lines has risen steadily from 259½ lakhs of maunds in 1884-85 to nearly 343½ lakhs in 1886-87. When their construction was on the *tapis* croakers by the dozen used to asseverate that they were sure not to attract traffic, and sure not to pay. To these dismal vaticinations the figures now before us give an emphatic and unanswerable denial. Perchance they may help to mitigate the force of melancholy prognostications when, in future, well-promising Engineering projects come to be considered. We note that the increase in traffic was most conspicuous on the Tirhoot line. One main reason for that is probably that the Tirhoot line is the oldest; has had most opportunity to inspire confidence amongst populations, naturally suspicious of any new thing, and as a consequence to attract traffic. The moral is very obvious, and is a hopeful one for Engineers. The Dacca State Railway, completed in February 1886, was in working order during the year under review, except for a short time during the heavy floods of September and October 1886. Of the total downward trade raw jute represented 80·54 per cent., and hides and skins 12·30 per cent. In the upward traffic, the principal article was European cotton piecegoods, which formed 35·31 per cent. of the total trade. Manchester ought to be told of that fact. It might induce some of her millionaires to be more helpful to the cause of Indian Railway construction than they have shewn themselves of late. Here is a quotation from our text which we commend, in that connection, to the notice of such old fogies as still believe in waterways as efficient competitors to railways. It runs: "In the report for 1885-86 it was explained that the abnormally large increase in the river-borne trade during that year was due to the temporary stoppage of goods traffic on the Eastern Bengal State Railway in September 1885 owing

to a breach caused by the floods. During the past year no such cause existed, and consequently this trade resumed its normal state."

It may interest some of our readers to hear that, in connection with Northern Bengal State Railway Traffic Returns, the greatest fluctuation occurred under the heading "Beer" and is ascribed to the business done by Messrs. Meakin & Co. at the Sonada Brewery, ten miles this side of Darjeeling. The troops at Darjeeling have taken kindly to the Sonada tap and the local Commissariat Department gets its supplies thence instead of from Calcutta. *Apropos* of spirituous liquors generally, it appears that the upward traffic of the province was almost the same as in the previous year, but below the figures of 1884-85 by 4,239 maunds.

THE WORKING OF THE FOREST DEPARTMENT IN THE NORTH-WEST PROVINCES AND OUDH.

CHAPTER VII. of Sir Alfred Lyall's review of his administration of government in the North-West Provinces and Oudh is devoted to the work of the local Forest Department between 1882 and 1887; and is a record of progressive, unsensational, useful work, which reflects credit on that Department. In 1887 there were 3,610 square miles of forest reserves in the united provinces, besides 70 miles of protected forests, and 118 miles of tree and grass jungle redeemed from waste in the Banda district. This last mentioned domain was bought from private owners at a moderate cost; and the purchase was determined on because the coppice forests, which formerly covered large areas in this part of the country, and which provided the people with wood and grazing in times of drought, were found to be rapidly disappearing before the plough, and under stress of demand from the railways and large towns. The forests in the Oudh circle are all Sub-Himalayan, and the other circles contain large areas of hill forests, valuable mainly for supplies of large timber, which, it is written, "private forests will soon cease to yield." *Apropos*; it is a moot point whether the forest areas presently available to meet the numerous calls made on their resources are as extensive as on economic grounds is to be desired. Decision as to this matter the author of the retrospect lying before us thinks, must depend largely on the industrial development of the country, and the increase of population. In all probability the time has gone by for any very extensive additions to existing area. The main thing to be cared for now is consolidation; endeavour to improve the condition and value of such present and potential timber supplies as the State has power over, and can nurse. In such directions there is need for expenditure of money; for a remunerative investment of money. We are glad to find that fair progress is being made towards the desired results.

With regard to the financial results of the Forest Department of Sir Alfred Lyall's government during the last five years, there has been steady improvement in the matter of earnings, which rose from Rs. 10,13,403 in 1883-82 to Rs. 15,73,556 in 1887. If all Indian Depart-

ments were as business-like, and as successful in business, taxes could be dispensed with, and we should arrive within more measurable distance of the millenium than Dr. Cumming's prophecies ever brought wistful humanity. In this connection it is noteworthy that the Forest Department's systems of toll and cess, in spite of consequently handsome balances on the right side of the books, are far removed from grasping or exorbitancy; are benevolent rather; communistic in the best sense of the word in the means adopted for their obtainment. Three-quarters of a million head of cattle graze in the forests of the North-West Provinces and Oudh—one-third of that number without any payment at all being made for the privilege, while from the other two-thirds little more than a nominal fee is levied. A great deal of grass, wood, and other forest produce is either given outright or sold at much less than market rates to villagers living near the reserves. Government, as forest proprietor, holds that the money loss occasioned by such generous procedure is the measure of compensation which it is proper to concede to communities whose perquisites have been unavoidably abrogated by its rules for forest conservation.

In the matter of surveys and demarcation, schedules full of particular information about the forests of the North-West Provinces and Oudh are reported to be in a more forward state than any others in India. In the said provinces some two-and-a-half lakhs of rupees are spent annually on communications and buildings, extensions and improvements. This outlay, which might legitimately enough be made chargeable to capital account is included in the ordinary expenditure of each year. The State paper before us says as to this matter:—"Not only therefore have the forests yielded a total surplus of 24 lakhs during the last five years, but they have also provided funds from which they have been greatly improved and made more valuable. Roads have been made for the easy extraction of timber; forest depôts and rest-houses for the storage of material and the housing of forest officers when on inspection duty; channels of streams used for floatage purposes have been improved; tow-paths formed along their banks, and booms and other like arrangements for catching the drift occasionally made."

The area in which measures for fire-protection were in force in 1887 was 1,800 square miles, against 936 in 1882. The area has been nearly doubled, that is to say, while expenditure has remained practically stationary. The precise measures adopted for fire-protection vary in different localities. In some forests, in order to give reproduction every possible chance, cattle are not allowed at any time to graze. This is the *hookm* as regards first class reserves of deodar in the Jaunsar division, and in the Oudh sál forests. In other preserves grazing is allowed except in the dangerous months, when cattle are entirely excluded. In many hill forests grazing is allowed all the year round, but the native practice of burning tall dry grass with view to a supply of green shoots is prohibited.

No material change in departmental constitution of

the Forest Service subject to Sir Alfred Lyall's authority was made during his term of office. There are critics and well-wishers outside the Department, who think that there ought to have been changes, who think that its officers, in consideration of good service rendered, and of the peculiarly remunerative forest outputs their efforts have secured for the State, are fairly entitled to more equitable consideration in the matter of pay and pension rules than they have received as yet at the hands of Government. In the case of subordinate rangers and foresters we find Sir Alfred Lyall admitting "the unpopularity which attaches to service in the forests, owing to the arduousness and unhealthiness of the work." For the higher grades the work is equally arduous, equally unhealthy. There ought to be for its members, as well as for members of the service in lower grades, compensating balances of generously adequate pay, to make amends for hardships and risks. Furthermore in that connection we agree heartily with the *laudator temporis acti* whose Retrospect we have in this writing been considering that it is desirable that a Forest Ranger who in that rank cannot hope to rise to more than Rs. 150 a month should be encouraged to hope, and to work for advancement to the higher grade of Sub-Assistant Conservator—when he has educated himself up to fitness for such a position, and has proved his fitness for discharge of its duties—not before. Under the existing dispensation promotion of a Sub-Assistant Conservator to the grade of Assistant Conservator is virtually impossible. Some modification of departmental rules thereanent is very desirable. It appears that Sir Alfred Lyall pressed the point upon the Government of India some time ago, and has since commended it to the notice of the Public Service Commission. With what result remains to be seen, in the future. Meanwhile it is our duty, as it is our pleasure to congratulate the Forest Department of the North-West Provinces and Oudh on a record of well-doing and successful crowning of endeavour that reflects the utmost credit upon all, higher grade or lower grade, who have been concerned with such details, and—tacts, shall we say—as have gone towards, and made for, completion of its satisfactoriness.

INDIAN RAILWAYS: A RETROSPECT.

EAST INDIAN RAILWAY.—Considering that this line has had for the last thirty-four years the monopoly of the trade of the country through which it has successively extended its operations, and the absence of any competition, there is very little in the report submitted to the shareholders at the half-yearly meeting held in January of the current year, upon which they may be congratulated. The chairman said that on the 1st July 1887 he estimated the gross receipts for the half year would be £2,369,766, and the actual result had been £2,364,362. If the exchange should not be unfavourable he hoped to divide £1-4s.-6d. per cent. as their share of the surplus profits, and the division now to be proposed was £1-5s.-6d. per cent. The working of the half year from July to December 1887 showed that the gross income was expected to be £1,971,933 the

expenses £618,750, and the net result £1,353,183. If the rate of exchange stood as it is at present the shareholders might expect to receive a surplus dividend of 12s.-6d. to 13s. per cent. as compared with 11s.-6d., 12s.-6d. and 8s.-9d. per cent. respectively, for the December half years of 1886, 1885, and 1884. The expenses were 31 per cent. of the income throughout 1887, notwithstanding free expenditure in replacing iron with steel rails, and wooden sleepers with iron. The relations of the East Indian Company with the North-Western State Railway were harmonious, but this was not the case with regard to the Bombay and Baroda, and Rajputana lines, the management of which "seem to employ the whole of their time in pilfering traffic" from the E. I. R. Here we may remark, that it is this wholesome competition, which certainly is not to the taste of the chairman, that helps to keep down the high rates which were the exclusive monopoly of the E. I. R. What the worthy chairman characterises as pilfering, is a boon to the public, and if a competitive line, running parallel to that railway, had existed in Bengal, we should not be constantly pestered with complaints as is the case now. Mr. R. Crawford was, however, compelled to "admit that the people of Bombay were ten times as energetic as the people of Calcutta." In regard to the progress of works of utility, he mentioned the Jubilee Bridge, which according to an official statement "answered the expectations of those who had called for its construction" and when the docks, now being built by Government, were completed the increase of traffic on the Jubilee bridge would be considerable.

BENGAL NAGPUR RAILWAY.—The accounts of this railway showed that the whole of the authorized capital £3,000,000 had been created, and £2,643,969 had been received. The expenditure came up to £1,120,953; of this sum £786,038 was on lines now open for traffic, £186,283 on lines which are now being constructed, and £108,106 on Working Stock. The gross receipts in revenue account for the quarter ending 30th June were £35,193, the expenses £15,048, and net receipts £20,145. The ratio of working expenses was 42.76 per cent. of the earnings, and the average length of the line open was 149 miles. The first portion of the new line, 41½ miles from Nandgaon to Raipore, was expected to be opened by June of the current year.

MADRAS RAILWAY.—The report of the thirty-fifth half-yearly meeting of the shareholders of this Company is a satisfactory record. The Bellary branch, a short line of 30 miles, was transferred to the Southern Mahratta Railway Company in February last year; but had continued to be worked by the Madras Railway Company until 14th May. The open mileage was 835. The gross revenue was £382,500, showing an increase of £23,000 over the corresponding period of last year, but the expenditure was very heavy, owing to the provision of eight new engines and over a hundred new carriages, the cost of which £23,000 was entirely charged to revenue. The net revenue in 1887 was thus less than that of 1886 by £12,500. Nearly one half of the increase in gross revenue amounting to over £23,000 was due to coaching traffic. The

result of lowering the fares of third class passengers from two pies to one and half pie per mile increased the number of travellers, as also the receipts by over £5,500. Between 1880 and 1887 the receipts from the coaching traffic have improved by £45,000, while the number of third class passengers has risen from one and three-quarter million to three and a half millions, and the annual earnings for this class from nine and a quarter lakhs to twelve and a quarter lakhs. The goods traffic shows an increase of £11,200. The material consigned to old material amounts to 9,300 tons, paying £4,000 as against 2,300 tons and £1,230 in the corresponding period of 1886.

BOMBAY, BARODA AND CENTRAL INDIA RAILWAY.—The capital expended during the half year amounted to £34,245 of which £6,935 was spent on rolling stock, £9,243 on stations and buildings, and £13,461 on ballast and permanent way. Receipts on account of Revenue for the half year ending 30th June were as follow:—Total receipts for 1887, £695,166, as against £722,180 in 1886. The expenditure on revenue account during the same period was £253,732 in 1887 as compared with £266,522 in 1886. The net earnings amounted to £441,434, calculated at 1s.-10d. per rupee. After payment of interest amounting to £16,479 on debentures and on advances received from Government, the balance remaining represents at the above rate of exchange £235,949. Deducting the necessary reserve towards the contribution payable in 1888 to the provident fund, the surplus for the half year divisible between the Company and the Government amounts to Rs. 25,25,834, the Company's share of which amounts to Rs. 12,62,917.

SOUTH INDIAN RAILWAY.—The total expenditure on capital account to 30th June of this Company amounted to £4,282,131, or at the rate of £6,548 per mile of Railway, including cost of rolling stock. The general results of working are as follow:—The net revenue or the six months of 1887 was £104,755 as against £77,650 for the corresponding period of 1886. The expenditure during the same period in 1887 was £143,733, as compared with £155,724 in 1886. The earnings under coaching and goods were as follow:—Half-year, 10th June 1886—Coaching, £122,295; goods, £107,656; half year, 30th June, 1887—Coaching, £135,232; goods, £109,736. The gross earnings for the half year under review exceed those of the corresponding period of 1886 by £15,154, and are larger by £10,385 than the receipts for the half year 31st December 1886, which were the highest previously recorded. The working expenses show in the aggregate a decrease of £11,951. The number of passengers carried in the half year was 3,479,370 (against 3,218,047), and the fares were the same in both periods. The third class traffic represented 98 per cent. of the total number and 94 per cent. of the receipts. In the goods traffic there is an increase in the receipts of £2,080. The gross tonnage of goods carried, exclusive of railway material and revenue stores, was 355,502 tons in 1887, against 372,306 in 1886 or a decrease of 16,804 tons.

Notes and Comments.

BENGAL P. W. D. RAILWAY UNDER-SECRETARYSHIP.—Mr. Hebbert from Lucknow has relieved Mr. Spring, and the latter left Calcutta on Wednesday last for Multan.

EXTENSION OF THE IMPERIAL MUSEUM.—An "Economic" Section is to be added to the present building in Calcutta, which is expected to cost from 2 to 3 lakhs of rupees.

A GRAVING DOCK FOR BOMBAY.—Sir John Gorst, replying to a question in the House, said that plans of the graving dock which it was proposed to build at Bombay had been submitted to the Admiralty, and estimates of the cost were in course of preparation.

U. C. S. ASSOCIATION (CALCUTTA).—We are glad to learn that a Committee Meeting last week has resulted in a complete agreement on all the disputed points. Mr. Buckley's Resolution, with some modifications, satisfactory to all sections concerned, was adopted.

SEEBPORE ENGINEERING COLLEGE.—The Draft Report of the Committee for the Reorganization of this Institution, is in circulation among its members, and we believe that it contains among other recommendations one for the abolition of the Government Workshops.

KIDDERPORE DOCKS.—The Calcutta Port Trust is to be congratulated on the rapid progress which the Kidderpore Dock works are making. Something like 2½ lakhs of bricks are used up every day. It is satisfactory to learn that Akra is able to stand this strain and more if necessary.

INDIA OFFICE—AGAIN!—The iron work for the Sholadi bridge on the Vayitri Gudalur Road, Southern India, was obtained, in the usual way, but on arrival was found totally different from, and about 50 per cent. heavier than, what was provided in the original estimate, and this causes an excess in the original estimate.

COCHIN HARBOUR.—Mr. Brunton's scheme for deepening the bar if successful, would give Cochin a splendid harbour. The Governor of Madras, in company with several members of the Cochin Municipal Council, personally inspected the locality, and found that the sea is rapidly encroaching, and the groynes constructed for the protection of the town require early repair.

FURTHER PROGRESS IN THE PHILIPPINES.—Messrs. Smith, Bell & Co., have laid an application before the Philippine Government to be allowed to construct a line of railway from Manila to Antipolo, a distance of about twenty-one miles. The estimated cost is \$895,391. No subsidy is asked from the Government. The Board of Public Works has reported favorably on the proposal.

RAILWAY CONSTRUCTION IN BURMA.—Good progress continues to be made with plate-laying. The rail head is now close upon Yemethin. Of the 230 miles of rail to be laid on the Toungoo-Mandalay Railway route, more than one half have been laid, and with the work going on vigorously at three sections, at the rate of about a mile a day, it is hoped that by July the line will be completed.

THE EASTERN BENGAL SYSTEM OF STATE RAILWAYS.—There is a report current that the Rothschilds "are negotiating for the complete purchase of some of the Northern Bengal Railways, especially those connecting Calcutta with the hills." It is thought in some quarters that "the change would be advantageous to the public, provided steps were taken to prevent an increase in the present rates."

"HOME RULE!"—The Superintendent of the Madras Harbour Works reported on the 10th December 1887 that a supply of cement was needed, no news having been received of the 2,000 tons asked for in July 1887, and on this exposure the Madras Government intimate in their order, dated the 11th January 1888, that the Secretary of State has been requested by wire to expedite the supply of the cement in question.

THE STRAITS SURVEY DEPARTMENT.—The Report on the Survey Department for 1887, shews that Colonel Barron's report, noticed in our columns lately, is still under consideration. The Colonel's indictment against the Department is strong and telling. The Colonel's Indian training and experience have biassed him against surveying arrangements that struck him as not in keeping with the scientific methods of the day.

THE KALKA-DELHI RAILWAY.—The Government of India have sent a despatch home on the subject of the offers made by the Bombay, Baroda, and Central India Railway Company and by Mr. W. Duff Bruce, C.E., in connection with the offer of Messrs. Andrew Yule and Company, of Calcutta, to construct a broad-gauge railway from Kalka to Delhi *via* Umballa and Kurnal. The Government of India is believed to entertain serious objections to both proposals.

RE-ARRANGEMENT OF THE CALCUTTA P. W. D. DIVISIONS.—More changes are likely to occur in the Bengal P. W. D. Divisions. The "3rd Calcutta" goes, and there will be a re-adjustment of the "1st" and "2nd" Divisions, which may also include Seebpore and Howrah if the "Workshop" Division is abolished. Possibly these reductions will better enable the authorities to provide for an Architectural Executive or Consultant, the need for which has been already discussed.

THE KASHMIR STATE RAILWAY.—The line about to be commenced by the Kashmir Durbar will run from Sialkot to Jammu, 25 miles, and is estimated to cost about half a lakh of rupees per mile. The Kashmir Durbar finds the money, Government guaranteeing 4 per cent. on the British section. The whole line will be worked by the North-Western Railway authorities for the first five years. The work will be carried out by General DeBourbel, who is acting as Chief Engineer to the State.

THE INDIA OFFICE.—The *St. James's Gazette* says:—The Honorable Mr. Evans, an unofficial member of the Legislative Council, seems to think that the Indian Government's home charges might be reduced, and that economies should be effected in the India Office. The latter suggestion is not at all an unsound one. The difficulty is to persuade the India Office that it costs too much. Some few years ago a voluminous report on the subject was prepared by Colonel Conway Gordon, R.E., but it has never yet seen the light of day.

THE HONORABLE THE MINISTER FOR WORKS.—Sir Charles Elliott will make a tour in the Southern Presidency before proceeding to Simla. The Public Works Minister is expected at Hyderabad early in April, and from there he will visit the Singareni coalfields, and inform himself as to the adaptability of the Buckingham Canal for carrying the produce of the coalfields from Bezvada into Madras. A Calcutta paper observes that it is a very strange thing if the carrying capacity of all these canals is not already known, without the special inspection of a minister who knows little or nothing about them.

AS OTHERS SEE US.—The number of the *Industrial Review* received by last mail contains the following

paragraph anent ourselves :—" Although still in its infancy' having been established but little more than a year ago, INDIAN ENGINEERING in the hands of Mr. Pat. Doyle, gives every promise of obtaining as high a reputation for professional ability and practical utility, as that enjoyed by its prototype and namesake, in London. Abuses, or supposed abuses, are criticised with freedom and fairness; whilst a vast amount of information, of value and interest to those engaged upon Indian works, is, week by week, brought together. It is well deserving of success."

BENGAL P. W. D. GUP.—The question as to who is to succeed Colonel C. M. Brown, R.E., as Chief Engineer, is still undecided. Colonels Luard and Steel and Mr. Martin are spoken of in this connection, but we are disposed to think that the appointment will be between the two R.E's. Rumor will have it that Mr. Martin is destined for a minor Chief Engineership, which increases the probabilities in favor of Colonel Steel. In that case Mr. Wickes would take Mr. Martin's Circle, and either Major McArthur or Mr. Joll would obtain Mr. Wickes'. Under any circumstances, some of the latter changes must occur when Mr. Anley retires later on this year.

SIMLA IMPERIAL WORKS CIRCLE, P. W. D.—As the work at the new Viceregal Palace at Simla is now drawing near completion, the order has gone forth for the abolition of the special branch of the P. W. D. formed in 1882 when the Government first determined upon erecting their new public offices at the summer capital. Mr. H. Irwin, M.I.C.E., the Superintendent of Works, and the Honorable L. M. St. Clair, Executive Engineer, will, however, remain for some time longer in charge of the new Viceregal Palace and the other public buildings at Simla, till the end of the season, when the maintenance and care of these edifices will probably be handed over to the charge of the Punjab P. W. D.

BENGAL DRAINAGE ACT.—The execution of the works comprised in the Rajapore Drainage scheme, is sanctioned, and the Executive Engineer of the Northern Drainage and Embankment Division will be the officer in charge of the execution of the works in conformity with the estimates and plans adopted by the Commissioners, appointed under the Act, at a meeting held by them on the 14th January 1885. The estimate of cost finally revised and published amounts to Rs. 12,74,863, including charges for establishment and interest during execution. On application to the Government of India for the necessary funds, that Government allotted Rs. 1,00,000 for expenditure on the works during the current official year 1887-88.

DIVISIONAL CHANGES IN THE P. W. D., BENGAL.—The Patna Division of the Western Circle is abolished from the 1st April next, and from that date all building works in the Gya and Patna districts will be transferred to the Eastern Sone Division. All the building works in the Shahabad district now included in the Patna Division, will be transferred to the Buxar Division. The Grand Trunk Road passing through the Gya and Shahabad districts will be under the charge of the Executive Engineer of the Chutia-Nagpur Division. A temporary Public Works Division, to be called the Kalimpong Division, and have its head-quarters at Kalimpong is formed. The Kalimpong Division will comprise all works in and north of that portion of the Darjiling district which lies east of the river Teesta.

ITEMS FROM CHINA.—There are rumors in Canton of a great earthquake having occurred in the provinces of

Yunnan and Szechuen, which reduced to ruins several cities and killed about 20,000 people.—The number of sufferers by the Yellow River floods is variously estimated from 1,600,000 to 2,000,000. A hundred thousand are said to have been drowned. Large parts of Honan and Anhwei are still under water. The Viceroy Li is said to have accepted the offer of a French syndicate to repair the gap in the Yellow River for Tls. 1,400,000 and to be inclined to accept a further offer on their part to repair the banks of the Yellow River for Tls. 10,000,000, with the guarantee that no floods shall occur for 30 years.

THE E. I. R. SHORTCOMING RE ROLLING STOCK.—A Correspondent writes :—The short supply of wagons on the E. I. Railway, more this year than any other, is, by people who ought to know, ascribed to the big 800 ton, and 1,000 ton trains, which block up so much rolling stock. These trains are not handy and run late. The other day one 1,000 ton train lost two hours between Burdwan and Asansol—and came into Raneegunge with hot bearings—and another engine was put on to help her up from Raneegunge to Asansol. Big unwieldy trains were pronounced a failure years ago in England and did not pay like the light quick trains. They—the E. I. R.—have now got to strengthen the wagon couplings; they are not strong enough for big trains. I saw the train come into Raneegunge. Every station master and driver on the line is against the big trains.

INSPECTORS OF DISTRICT BOARD WORKS—WANTED.—A Superintending Engineer, Madras, points out that the common practice for departures to be made from sanctioned plans and estimates in carrying out Local Fund works without anything being said till the works are completed or nearly so, reduces the value of the nominal check, which Superintending Engineers are supposed to exert on important Local Fund works, to practically nil. Why not introduce the "Divisional" or "Inspector" system of supervision as in operation in Bengal and the N.-W. P. and Oudh? The necessity for such a course is all the more apparent from the fact that under orders of Government a charge of 2½ per cent. on the amount of all estimates submitted for the scrutiny of Public Works Officers is made on Local Funds by the Public Works Department, Madras, and the charge is made in some cases where revised estimates are submitted for scrutiny.

A PROPOSED RAILWAY SCHEME IN THE CENTRAL PROVINCES.—Mr. D. Wallace, Executive Engineer, has prepared a report on a proposed railway of sixty-five miles' length, to run from Nagpur, *via* Umrair, to Burhampuri, in the adjoining district of Chanda. The country, though not hilly, is difficult for the construction of a railway, and neither timber nor much of the material for masonry can be procured on the spot. The estimated cost of the line, with ample allowance for contingencies, will be twenty lakhs of rupees on the metre gauge, and fifteen lakhs on the 2ft. 6in. gauge. To pay interest on the capital, and meet working expenses, the gross earnings would require to be Rs. 650 a day. Mr. Wallace has however found that the usual traffic along the line of the proposed railway only comes to Rs. 280 a day. But he was told that a considerable amount from the Chanda and Bhandara districts went *via* Kanpa to Hinganghat, which would go to Nagpur if the line were constructed.

LIGHTNING AT LUCKNOW.—The Martinière College had a wonderful escape during a recent thunder-storm. The electric fluid in its descent darted about the building in

the most extraordinary and erratic manner. It first struck and splintered the flagstaff, and then running down the iron supports, leapt from them into two of the turrets, where, after dislodging a good deal of plaster, it flew along the doors from bolt to bolt, smashing the glass and rending the wood-work in all directions. After thus cleaving its way through some half dozen stories, searching out in the most remarkable manner every bit of iron in its course, it struck through the floor immediately over the Principal's dining-room, which, being in the heart of the large building, might have been supposed to be impervious even to lightning. Here it ran straight down the iron rod supporting the chandelier and dashed into the dining table beneath, shattering a tray which stood upon it and tearing out large pieces of wood from the table in its search for one of the iron bolts beneath, from which it sprang to the floor, finally escaping through one of the open doors.

ALLAHABAD WATER-SUPPLY.—It is stated that the local Government have intimated to the Allahabad Municipality that they are prepared to appoint a specialist on their own account, who will prepare plans and estimates for carrying out the water-supply scheme. It is proposed to give the services of a resident Engineer, with necessary establishment and accounts. The Government will charge the Municipality a fixed percentage on the entire cost of carrying out the scheme, and this charge will not exceed the cost which the Municipality are prepared to lay out. The Government further guarantee a certain specified supply of water for a fixed sum of money, and offer to take upon themselves the entire responsibility of failure. After their plans and estimates, as drawn up by their specialist, have received the approval of the Municipality, the Government will be responsible for any excess of expenditure over the estimate, and thus relieve the Municipality of all risks involved in carrying out the project. This offer has been accepted. The Local Government advance a sum of 12 lakhs for the purpose of carrying out the scheme, the interest on which is to be met by a house tax. The Military Department of the Government of India contribute two lakhs to the project in view of its value to the cantonments.

LUCKNOW WATER-SUPPLY.—Some time back Major Allan Cunningham, R.E., submitted a very complete report on this subject, in which he gave the Municipality the choice of three schemes—first, a special canal of 80 miles length, to be taken out of the Gumti River; second, pumping from the Gumti at a site just above the city; third, an Artesian well or wells. The initial cost of these schemes, including 31 miles of distribution piping and storage tanks, was put at—(1) Canal project Rs. 24,40,000. (2) Pumping from the Gumti Rs. 21,44,000. (3) Four Artesian wells Rs. 16,21,000, while he put the annual maintenance in each case, including interest on the above capital expended, at—(1) Canal project Rs. 4,03,000. (2) Pumping from Gumti Rs. 5,10,000. (3) Artesian well Rs. 98,000. Apart from the very large initial outlay involved in the first two schemes, the heavy annual charge for maintenance involved practically, put those schemes out of consideration; and the Board, therefore, was compelled to adopt the Artesian well project. The Municipal Board in making its arrangements is prepared to go as far as 2,000 feet, and it is commencing with a hole of ten inches. It has obtained its plant from a well-known firm in New York, and the rig is fitted for the very heaviest work that can be demanded of it. It has cost, landed at Lucknow, about Rs. 30,000. With

the plant has come a professional Artesian well-engineer who has sunk wells, or been called in to give advice in difficult cases in twenty-eight out of the thirty-eight States in America. The derrick is up, and within a few days the first pipe will be driven.

SOUTH INDIAN RAILWAY BUDGET ESTIMATES.—The cash outlay on Engineering works for 1887-88 is estimated at Rs. 4,91,499, the principal items being—

	Rs.
Protective works to bridges	45,101
Permanent diversion of line and constructing one	
—150 feet girders over the Opanar... ..	26,797
Lowering bank between 44 miles 37 chains and	
46 miles 13 chains	47,791
Curtain walls, &c., over Palar	34,980
Adding four 25 feet girders at 77-1 mile	10,374
Raising the Paravanar bridge	35,199
Lowering gradient between 122 miles 11 chains	
and 123 miles 66 chains	20,851
Extension of Workshops at Negapatam	26,556
Additional accommodation at Egmore	26,690

For 1888-89, the outlay on Engineering works is estimated at (the total of schedule A) Rs. 2,59,094, the principal items being—

	Rs.
Protective works to bridges	62,000
Adding two 100 feet spans to Tondayar	36,251
Adding 11 spans to Gingi bridge	56,029
Bridge of four 40 feet girders at 134-10 miles	18,932
Bridge of four 40 feet girders at 134-15 miles	21,774
Curtain walls, &c., to Satur bridge at 389-7	
miles	17,370

RECOMMENDATIONS OF THE PUBLIC SERVICE COMMISSION RE THE PUBLIC WORKS DEPARTMENT.—That the Engineer Establishment of the Public Works Department should consist of an Imperial Branch and of Provincial Branches. That the Imperial Branch should consist of such a number of Royal Engineers as may be required as a reserve for military purposes over and above the officers employed in the Military Works Branch, and of Civil Engineers recruited in England. That the strength of the Imperial Branch should not be greater than is necessary for purposes of control and direction, and for the execution and repair of works calling for high Engineering skill, and that the recruitment from the Cooper's Hill Royal Engineering College, which appears at present excessive, should be regulated accordingly. That the conditions of service in the Imperial Branch should be fixed with a view to secure the necessary qualifications in England, and should, as far as possible, be uniform for all officers employed in it. That the Provincial Branches should be of a strength adequate for the construction and maintenance in the several Provinces of works not ordinarily calling for high Engineer skill. That the recruitment for the Provincial Branches should be made by the direct appointment to the lowest grades of qualified Engineers from the Indian Engineering Colleges, and in exceptional cases by promotion from the Upper Subordinate grades. That there should be at least one college in India thoroughly well equipped for providing a high education for Engineers for the Provincial Branches, and that such college should be open to all classes of Her Majesty's subjects. That the conditions of service as to pay, furlough, and pension should be fixed for the Provincial Branches without reference to those of the Imperial Branch.

Current News.

THE construction of the Kashmir Railway has at last been sanctioned, and will be commenced forthwith.

MR. GRIESBACH, the Geological Survey officer, who has entered the service of H. H. the Ameer, arrived at Jalalabad on the 10th February.

MR. HARE, of the Telegraph Department, accompanies the Sikh Expedition in charge of the construction party which will have the laying of the line between the camp and Darjiling.

THE Geological Survey Officer (Mr. La Touche) who was sent to report on the recent discovery of coal in Kashmir, has concluded his investigation—it is not yet known with what result.

THE actual expenditure on the Punjab Chiefs' College building has been up to the end of July last, Rs. 56,500, and a further sum of Rs. 60,000 is estimated as the cost up to the end of last month.

FRESH efforts are to be made in the Forest Department to establish the manufacture of turpentine from resin to be procured by tapping trees of *Pinus Longifolia* and *Pinus Excelsa* in Government forests.

MR. H. B. MOLESWORTH, the District Engineer in charge of the Coalfields, has severed his connection with H. H. the Nizam's State Railway, and has joined Mr. Balakrishna, the Contractor, in business.

THE Rangoon Port Trust have been experimenting with the electric light on their wharves. Lamps of 3,000 candle-power have been erected on the Phayre Street wharf. The installation for each wharf will, it is calculated, cost about £400.

SIR CHARLES ELLIOTT on his recent visit to Orissa was fully satisfied with the carrying capacity of the Coast Canal to meet all famine exigencies. It is estimated that thousands of tons of grain could be sent into Orissa daily by this means.

THUNDERSTORMS with heavy rain lately visited Nagpur and Kampti breaching a diversion on the Bengal-Nagpur Railway near the Cavalry Lines at Kampti, and an engine subsiding with the bank. Through traffic on another diversion has been resumed.

COLONEL WOODTHORPE, R.E., who has been placed on special duty for the purpose of compiling the report of Colonel Lockhart's expedition to the Hindu Kush will, we understand, eventually succeed Colonel Bell as head of the Intelligence Branch in India.

THE members of the Sone Canal Committee are in Calcutta compiling their report, which will be with the Bengal Government by the middle of March. It is believed they will recommend the Italian system of irrigation work, adapted to the circumstances of South Behar.

ON the 28th February a collision between Goodstrains occurred at the Jandiala Station of the North-West Railway. The engine of the down train was smashed, and the rolling stock was seriously damaged, but fortunately no person was injured. Coolies have been sent to the spot, and it is hoped that no interruption will be caused.

THE Karachi Municipality are laying down a pavement composed of small blocks of wood of the *Acacia Indica*, or *babool*, from the Merewether Tower to the Custom House as an experimental measure. The blocks are laid on a well-beaten bed of concrete with the grain running perpendicular, and are closely fitted together with cement.

MR. GUILFORD MOLESWORTH, the Consulting Engineer to the Government of India for State Railways, accompanied by Mr. J. W. Buyers, the Engineer-in-Chief, Burma Railways, left Rangoon on the 29th ultimo on a tour of inspection of the Burma lines, and the work in progress on the Toungoo-Mandalay extension.

IT is settled that the office of the Director-General of Railways will be amalgamated with the Public Works Secretariat of the Government of India from the 1st of April. A month's notice has been given to all the temporary hands employed in the Secretariat who are to go, to make room for the men to be taken over from the Director-General's Office.

A NATIVE artisan employed on the East Indian Railway met with a serious accident early on Wednesday (29th ultimo) morning in the Pundooah station yard. He was knocked down by the buffers of a passing train, and falling partially across the rails had his left leg severed above the ankle. Pundooah is becoming uncomfortably notorious for railway accidents.

THE Government of India has sanctioned the extension of the estimate for remodelling the Ganges Canal to the 31st March 1891. The prosecution of certain further works, such as the construction of a navigable channel to connect the Ganges Canal with the Agra and Western Jumna Canals, and the raising of the different

bridges on the Main Canal, to give sufficient headway for navigation, have been ordered to be deferred for the present, owing to existing financial exigencies.

At the last meeting, General Black, President of the Municipal Committee, proposed that in consideration of the long and valued public services of the late Rai Bahadur Kanhya Lal, Executive Engineer, the Committee should record a sense of their deep regret at his sudden death. It was also decided that a portrait of the late Rai Sahib should be ordered by the Municipal Committee from England, for the New Town Hall. The details were entrusted to a Sub-Committee composed of five members.

Letters to the Editor

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.

HOOGHLY BRIDGE CANTILEVER.

SIR,—Your correspondent "C. F. F." in issue of 25th February needs no apology to correct any error in my letter of 3rd December.

I had rather be corrected than remain in error, and am quite open to conviction, however much I may cherish the theory in dispute.

He is quite right in supposing that a working Engineer in this country has not much time to devote to theoretical subjects. Possibly if I had leisurely revised my letter, I should have detected the errors, which are so obvious that I cannot think how I committed them, and would have modified the concluding paragraphs, which I admit are too sweeping, especially as my own position was not impregnable.

The method that I proposed, only holds good in the case of parallel chords, but I do not follow "C. F. F." in his statement that my treatment is inconsistent in the three sections (see the



fig. where the dotted lines form the connecting link). I have throughout supposed the joints hinged, so far as the deflexions are concerned. In the middle section the attachments to pier are just as much supposed hinged as in the first, and in the third, although I said "the unloaded end is fixed at the pier," I further stated that the resistance it could as a beam offer to upward deflexion, was so small that it would not produce appreciable extension in the members pulling it upwards, which is much the same as if it were actually hinged.

It makes absolutely no difference to any part of my argument, whether the unloaded end is supposed free to rotate, or fixed, but unable to offer any effective resistance to bending. So that I have throughout supposed the joints hinged, which "C. F. F." himself thinks best.

The injustice I committed was upon the post over pier, in not allowing it to partake in the general deformation, and in not giving it the benefit of fixity at both ends alike, thereby exaggerating the strain upon it.

The little joke about the patent pin is justified by my having used the expression "no secondary strain," but I did not suppose even a pin joint to be absolutely frictionless.

Even with these corrections, the general case stands very much where it was. I do not suppose that "C. F. F." will deny that this particular structure would be less subjected to secondary strains if it were pin connected, or that he will defend the practise of counterbracing the main ties of girders which have always sufficient tension upon them to keep them tight, as I have seen in some large bridges in this country.

Another point where English practise differs for the worse from American, is in the wind bracing. This is always adjustable in America, and never in England, even between the compression chords, so that bracing put in before the bridge is swung must be slack when the chord is compressed by the load, unless it has received an initial tension equal to the future compression of the chords and this cannot be given by drilling the rivet holes with a "draw" even if it is supposed to be done, for the only result of that arrangement is to enlarge the rivet holes in drifting them up.

I am very sure that had most of the large bridges in this country been open to tender from any country, to include design and cost of erection, very few of them would have come from England.

F. E. R.

KEEPING UP A ROAD.

SIR,—In reply to "Revenge," my idea of the matter is this:—

If a road is in generally bad order, gangs of *naukar* coolies must be kept on all the year round; but with a road in fairly good order my practise is to collect all required repair metal between April and June, as soon as the rains begin, to put on several gangs to repair. Two months or so will finish the job for good, and for the rest of the year I let the road rip. This is a much more economical and effectual method than keeping gangs of men dawdling out of the road.

DEODAR VERSUS STEEL SLEEPERS.

SIR,—In your issue of the 11th instant your correspondent "F. R. U." has added a contribution to this discussion which is at least backed by mature experience and not "evolved from an inner consciousness."

It was my good fortune—some years ago—when running the transport on a ghât line, to have witnessed an unique series (time for time) of heavy accidents occurring over the three varieties of sleepers—deodar, D. & O., and the steel. A page or two from my diary will tend to modify "F. R. U.'s" experience—i.e. :—

(a) "He also, I think, over-estimates the consequences of derailment in the case of steel sleepers."

(b) Para. 2.—"My experience is that just as little damage is done to steel sleepers as to wood sleepers in case of accidents."

The following details may be of interest on this point :—

I.—STEEL SLEEPER ROAD.

(1) Date.	_____			
(2) Location.	_____			
(3) Nature of Accident.	One Engine—"L" class—with 14 vehicles loaded with rails and sleepers. Engine coupling parted at mile—grade 1 in 45. Derailed vehicles at mile—grade 1 in 60. Vehicles (6) ran on sleepers for 3 chains.			
(4) Damage.	Rolling Stock.	_____		
	Permanent Way.	Fastenings.	Nil—keys repairable.	
		Sleepers.	All unserviceable.	
		Rails.	Two pairs.	
(5) Detention.	_____			

II.—D. & O. SLEEPERS.

(1) Date.		_____	
(2) Location.		_____	
(3) Nature of Accident.		3 Engines coupled with 38 empties. Derailed central Engine at curve No. grade 1 in 60. Coupling of pilot parted : pilot stuck to road. Train ran four rail lengths until brought up by side drain of cutting.	
(4) Damage.	Rolling Stock.	_____	
	Permanent Way.	Fastenings.	Tie bars destroyed.
		Sleepers.	All broken.
		Rails.	4 pairs renewed.
(5) Detention.		_____	

III.—DEODAR SLEEPER ROAD.

(1) Date.	_____			
(2) Location.	_____			
(3) Nature of Accident.	1 Engine— <i>L</i> class—with 30 vehicles derailed at diversion mile— <i>N</i> side of grade 1 in 45, 3 rail lengths from level. Ran on sleepers for 5 rail lengths until brought up by up grade.			
(4) Damage.	Rolling Stock.	_____		
	Permanent Way.	Fastenings.	Some spikes useless.	
		Sleepers.	Badly indented. 2 renewed.	
		Rails.	Nil.	
(5) Detention.	_____			

These are typical cases, and as evidence from a strong partisan in favour of the steel sleeper, the advocates of wood may score their point. But the question will be settled on a higher platform, at least in this N.-W. corner of India. "F. R. U." with his usual insight has struck the main issue which must oust the use of wood for sleepers, and he has rung out a timely note of warning against the inappropriate application of timber. The ultimate effect on this corner of India of the daily extending use of wood, especially for Engine fuel, has probably never concerned the Loco. Superintendent or his Manager, seeking his "bubble reputation" in a Reduced Working Expenses Sheet. But their present policy of unconcernedly consuming a people's sole fuel supply regardless of posterity can have but one result ; and which, can, too easily, be predicted.

As long as this fuel supply was under the forest's control the danger was minimized, but now the suppliers have gone farther a-field. Here regardless of consequences every stick is cut—the shrubs even are sacrificed. Who can too strongly condemn a policy which encourages—nay, has initiated—this wanton destruction of young timber ! For it is a policy that must end in destitution, denudation, and then—a desert.

February 22, 1888.

T. H. E.

"AN ENGINEER'S LIBRARY."

SIR,—In further reference to the subject of an Engineering Circulating Library and Journal Club, I would wish to say, that I think most members of the profession would be quite *en accord* with the proposition put forward by Mr. Gwyther in your issue of the 18th February.

But, I myself think, it is absurd to expect Government assistance in a matter of this kind ; in fact we should be much better without it. One thing is pretty certain—we should never get it even if we *did* want it.

There are so many Engineers in India (Government servants and others), that I am convinced that a project of this kind, *once started*, would succeed. But we want some influential and energetic members of the profession to set the ball a-rolling, as among the great majority of us, the 'vis inertia' is so strongly developed, that I doubt if anything would come of it. What is everybody's work is nobody's work ; and no one would take the trouble and bother. What I propose now is that a representative committee be formed in Calcutta, that circulars be sent to Engineers all over the country, asking if they will join, and, if the replies be satisfactory, subscriptions in advance be called for. Our thanks are certainly due to Mr. Gwyther for bringing the matter forward.

W. G. BRYCE

TABLES FOR ROLLED IRON BEAMS.

SIR,—That there should be a demand for Lalla Ganga Ram's tables for rolled beams (*vide* page 131 of your issue of 14th January) is an extraordinary example of the tendency of men to accept unquestioned anything they see in print. Surely it must be evident to any one, who has read his article in your issue of 8th October 1887, that these tables are wholly unreliable.

They are based on a formula quoted from Trautwine, which enunciates that the deflection of a rolled beam varies inversely as its sectional area multiplied by its depth. Heaven knows where Trautwine got this formula, but everybody knows, or ought to know, that the deflection varies inversely on the moment of inertia of the section, and that this does not vary in the above simple ratio, except for sections of similar figure and proportions. Hence it is evident that Trautwine's rule can only be true for some particular figure of section and is untrue for all other sections not strictly similar thereto. The question then arises, within what limits is the rule sufficiently accurate for practical purposes, and the following example will shew that these limits are much narrower than those between which the sections in the market vary.

But there is a still worse error. These tables profess to give us the "safe load" that which will give a deflection of one-fortieth of an inch per foot of span. This particular proportionate deflection was, I believe, adopted by Tredgold or some one else in the last century as that most suitable for timber joists carrying lath and plaster ceiling, but no authority worthy of the name has ever shewn that it is a proper one for iron beams in a country where lath and plaster ceilings are exceptional. The proper criterion of safety for an iron girder, is either the proportion that the load on it bears to that which would break it, or else the maximum stress induced by the load in the fibres of the metal. In the absence of experiments on the former, the latter must be deduced theoretically, and, as everybody knows, this stress varies (for a load of given intensity per unit of span) inversely as the moment of inertia, and directly as the *square* of the span.

But the formula on which these tables are based is as the *cube* of the span, and therefore the tables can only be correct for some particular ratio of depth to span, and are totally unreliable for every other ratio, sometimes erring on the side of safety and sometimes on that of danger.

The following examples will make this clear. Take the beam 8" x 2½" weighing 15lbs. per foot. The moment of inertia of this section will be found to be 39 inch units. The "safe load" given in the table for 12 feet span is 750lbs. per foot, *i.e.*, 62½lbs. per inch, which includes the weight of the beam itself.

$$\therefore \text{deflection in inches} = \delta = \frac{5}{384} \times \frac{wl^4}{EI} \quad (l \text{ being in inches.})$$

$$\begin{aligned} \therefore \text{deflection per foot of span} &= \frac{12\delta}{l} = \frac{5}{32} \times \frac{wl^3}{EI} \\ &= \frac{5 \times 62\frac{1}{2} \times 144 \times 144 \times 144}{32 \times 18000000 \times 39} \\ &= \frac{1}{24.07} \text{ inches per foot of span.} \end{aligned}$$

(The value of E is that given by Stoney for rolled beams—see page 180 of the edition of 1873.)

$$\begin{aligned} \text{Also maximum stress} = p &= \frac{wl^2}{8} \times \frac{d}{2I} \\ &= \frac{62\frac{1}{2} \times 144 \times 144 \times 8}{8 \times 2 \times 39} \\ &= 16,615 \text{ lbs. per sq. inch.} \end{aligned}$$

Again for 24 feet span, the safe load is given as 93lbs. per foot;

$$\begin{aligned} \text{then deflection per foot of span} &= \frac{5 \times 7.75 \times 288 \times 288 \times 288}{32 \times 18000000 \times 39} \\ &= \frac{1}{24.3} \text{ inches per foot,} \end{aligned}$$

$$\begin{aligned} \text{and maximum stress} &= \frac{7.75 \times 288 \times 288 \times 8}{8 \times 2 \times 39} \\ &= 8,241 \text{ lbs. per sq. inch.} \end{aligned}$$

Now contrast these results with similar ones for a beam of the same depth, but different proportions, *e.g.*, 8" x 6" weighing 34lbs. per foot, the moment of inertia of whose section will be found to be 107 inch units.

The table gives 1,700lbs. per foot as safe load for a 12 feet span; this gives by similar calculation to the above

$$\begin{aligned} \text{deflection per foot of span} &= \frac{1}{29.1} \\ \text{maximum stress} &= 13,727 \text{ lbs. per sq. inch.} \end{aligned}$$

For 24 feet span, 212lbs. is said to be the safe load per foot, and then

$$\begin{aligned} \text{deflection per foot of span} &= \frac{1}{29.2}; \\ \text{maximum stress} &= 6,847 \text{ lbs. per sq. inch.} \end{aligned}$$

Thus, the "safe loads" given in the tables when checked by theory, give deflections varying from ⅓th to ⅓th of an inch per foot of span, and stresses varying from 3 to 7½ tons per square inch; so it is to be hoped that those who have stuck such unreliable

tables in their Molesworth, will tear them out again before any mischief results from their use, and that Lalla Ganga Ram, or somebody else with leisure and a turn for arithmetic, will give us a table of the moment of inertia of the usual sections in the market.

If it be objected that the results of theory do not agree with those of practice, it will surely be admitted that Mr. Benjamin Baker is at least as good an authority as Trautwine, and that the above results may be corrected by the rule he gives in his paper on the "Practical Strength of Beams" (Min. Proc. C. E., Vol. LXII., page 269) *viz.*, "the increase in the elastic strength over the theoretical amount approaches 70 per cent. in the same ratio as the sectional area of the beam approaches the area of the circumscribing rectangle." Applying this to the 8" x 2½" beam whose sectional area is 4½ square inches we obtain for 12 feet span—

$$\begin{aligned} \text{maximum stress} &= 16,615 \div \left\{ 1 + \frac{70}{100} \times \frac{4.5}{8 \times 2\frac{1}{2}} \right\} \\ &= \frac{16615}{1.157} = 14,360 \text{ lbs. per sq. inch.} \end{aligned}$$

For 24 feet span

$$\text{stress} = \frac{8241}{1.157} = 7,123 \text{ ,, ,,}$$

Similarly for the 8" x 6" beam of 10.2 sq. inches area for 12 feet span

$$\begin{aligned} \text{stress} &= 13,727 \div \left\{ 1 + \frac{70}{100} \times \frac{10.2}{8 \times 6} \right\} \\ &= \frac{13,727}{1.149} = 11,947 \text{ lbs. per sq. inch.} \end{aligned}$$

For 24 feet span

$$\text{stress} = \frac{6847}{1.149} = 5,959 \text{ ,, ,,}$$

This, however, does not justify the tables any more.

I hope that, should anyone object to the above criticism, some one near Calcutta will take up the cudgels in its defence, for it is my misfortune to live about a week's post from Calcutta, and to have little leisure, otherwise I would have said my say about these tables long ago.

QUETTA; February 24, 1888.

C. W. HODSON.

P.S.—There are many ways of finding the moment of inertia, but the following seems best adapted for symmetrical rolled beams as it assumes, as given, only those four quantities which are most easily measured, *viz.*, the depth, breadth, and sectional area of the beam, and the thickness of its web.

Call these quantities *d*, *b*, *a*, and *t*, respectively. From these deduce the following

$$\text{area of each flange excluding web part,} \quad a_1 = \frac{a-bd}{2};$$

$$\text{mean thickness of same} \quad t_1 = \frac{a_1}{b-t_1};$$

$$\text{distance of centre of same from neutral axis of beam} \quad x = \frac{d-t_1}{2}.$$

$$\text{Then moment of inertia} \quad I = \frac{bd^3}{12} + 2a_1x^2 \text{ nearly}$$

This result will rarely be as much as one per cent. in excess of the true value, and this method avoids the difficulty of measuring with sufficient accuracy the *mean* thickness of the flanges. It would be a good thing if firms would add "thickness of web" to the other particulars of rolled beams in their catalogues.

C. W. H.

"STAR OF BETHLEHEM."

SIR,—Venus has been misbehaving. Let it not be supposed that INDIAN ENGINEERING is responsible for the libel. Mr. Pogson, the Government Astronomer at Madras, is its author. He is angry with the so-called star of Bethlehem, and the unscientific character of popular imagining as to its astronomic properties, proprieties, and aspects; and he uses bad language and indulges his spleen at poor Venus's expense. She was, he roundly declares, "the cause of the late silly, ignorant mistake." In this wise:—"She was nearest to the earth, rising and setting with the sun, and 59" in apparent diameter on 18th September. Seen then with a telescope she has a crescent of thread-like fineness; the widest part of the crescent less than a hundredth part of the disc, *i.e.*, of the width between the extremities of the horns. The greatest brilliancy was attained on 28th October, when she rose at 3h. 9m. A.M., and had a diameter of 38" appearing as a well-formed crescent, like the moon when about four days before new. This was the time when the stupid, unscrupulous misleaders of the public began to rave about the star of Bethlehem. The craze, once started, was easily kept up by fanatical sentimentalists, as Venus remained a splendid object until her greatest western elongation on 1st December. She then rose at 2h. 58m. A.M., and was a neat, pretty little half-moon in the telescope, with an apparent diameter of 25." On 2nd January she made an apparently near approach to Jupiter, which was then mistaken for Venus, the latter being called the Star of Bethlehem by many who should have known better." These italics are not mine. They are the outcome of

the Madras man's sufficiency. Who has been rude enough to suggest that Venus's telescopic figure was at any time "gibbous?"—whatever that bit of scientific Billingsgate may be held to mean. But, understanding somewhat of the perplexities dogging the heel of mistaken identity, I am glad of Mr. Pogson's assurance that in future no one is likely to mistake gibbousness for the Star of Bethlehem. A far more eligible candidate for the post of honour might be found, he thinks, in what is called "Kepler's Nova of 1604" as it was in the right place, i.e., near to Scorpio, and brighter than Jupiter. Only, "there is no reason to suppose that it was ever seen before—especially not about 1 A. D." Could not this pretty little quarrel be satisfactorily arranged by re-christening the Star of Bethlehem and calling it Mr. Pogson?

F. R. A. S.

MORE RAILWAY ACCIDENTS.

SIR,—In your issue of last Saturday, I notice an article under the above heading which has reference to "an accident at Mokameh Ghât, which states that thirteen wagons were damaged. I trust you will allow me to contradict the statement as I was present there shortly after the accident; only two wagons were damaged, and those very slightly, neither has the pointsman "been arrested." The accident happened on the 9th instant at about 10-30 P.M.

J. T. ROBINSON,
P. W. Inspector.

MOKAMEH; February 27, 1888.

METAL TRACK FOR RAILROADS.

SIR,—I am at present engaged in collecting all available information with regard to the above, and as I understand that metal ties (sleepers) are quite extensively used in India, I write to ask if you, or your readers, can kindly give me some information respecting their use, or refer me to Engineers or railroads using them.

The information is desired for the purpose of a report to the Department of Agriculture, which department has recently had under consideration the serious destruction of forests for timber for railroad purposes. The circular below outlines the information desired in reference to the different roads.

The subject is a very important one, and it is my aim to make the report as complete and detailed as possible, collecting and noting the scattered literature relative to the matter, but dealing more especially with recent practice and present systems adopted. Any information will be appreciated.

Hoping to be favored with communications from India on this subject.

E. E. RUSSEL TRATMAN, A. M. Soc. C. E.

114, REMSEN STREET, BROOKLYN, N. Y., U. S. A.; }
January 24, 1888.

INFORMATION WANTED.

- RAILROAD.— 1 Name.
2 Route.
3 Length of lines laid with Metal Sleepers.
4 Character of same. (Particulars of grades, curves, etc.)
5 Dates when laid.
6 Engineer in charge.
7 Character of traffic.
8 Weight of Locomotives, and weight on driving wheels.
- SLEEPER.— 9 Longitudinal, transverse or bowl.
10 General form.
11 Dimensions, including thickness. (Figured drawings.)
12 Weight.
13 Material.
14 Spacing centre to centre.
15 How treated. (Paint, anti-rust process, etc.)
16 Manufacturer.
17 First cost, at factory or delivered.
18 Expense of maintenance.
19 Attachment of rails. (Details and drawings.)
20 Arrangements for curves.
21 Tie rods; if used, how attached and adjusted for gauge.
- TRACK.— 22 Durability.
23 Material of ballast.
24 Behavior of ballast under sleeper.
25 Construction of roadbed. (Drawing.)
26 Section and weight of rail.
27 Rail joints; how made.
28 Rail joints; on sleeper or suspended.
- 29 Reasons for adopting metal sleepers.
30 General results; satisfactory or otherwise.
31 Is there trouble with maintenance of track.
32 Is there trouble with rail attachments.
33 Is there trouble from breakages; how and where do they usually occur.
34 Efficiency, etc., as compared with wooden sleepers.
35 Cost, material and durability of wooden sleepers.
36 Climate; and effect of same on metal or wooden sleepers.
37 General remarks.
38 Opinions.

E. E. R. T.

Literary Notices.

SOME TEXT-BOOKS ON ELECTRICITY.

THE immediate incentive to the production of this article is the appearance of a little work intended to teach by experiments Electricity to school classes. The title is "*Practical Physics for Schools*." The authors are Messrs. Stewart and Gee. This work is a sort of extract from a larger work called "*Lessons in Elementary Practical Physics*," by the same authors. Both works are excellently adapted to the ends in view.

Electricity is now so large a subject—it has so much detail—that no little book is able to do more than skim the subject. For a student who wishes to take up the subject thoroughly—and who is able to read French there is no better introduction than the "*Traité d'Electricité*" by J. Gavarret. This work is, however, now scarce and probably is most easily procured through second-hand booksellers. The older works on Electricity shew less respect to Volta's Contact theory of potential than is consonant with modern ideas. They also sometimes describe the action of condensers as if much of the Electricity became latent as does heat which enters into ice and changes the ice to water. But notwithstanding these defects, we find in old works like that of Gavarret, or that of De La Rive, an excellent—because not unduly condensed—account of the chief principles of the science and the chief instruments which illustrate or apply those principles.

The ample discussions which such books contain contrast very favorably with the obscure—because meagre—explanations to be found in such books as Thompson's or the text-books by Ganot and Deschanel. For a careful discussion of the principles of Electricity, the student may be referred to "*Leçons sur l'Electricité et le Magnetisme*" by Mascart and Joubert. The publisher is G. Masson, Paris.

The authors intended to complete their work by a volume describing electrical apparatus, but this supplementary volume—as far as the present writer knows—has not been issued. There is, however, a work in four parts by C. M. Gariel, which deals entirely with apparatus. The work is entitled "*Traité Pratique d'Electricité*." The publisher is Octav Doin, Paris. Perhaps the appearance of this work caused Messrs. Mascart and Joubert to refrain from introducing their own book.

So many intelligent minds are now at work improving electrical apparatus that by the time an author has got his descriptions into print some of the instruments he has described have become out of date. This is an additional reason for Messrs. Mascart and Joubert to content themselves with their one volume.

Of English works we have "*A Physical Treatise on Electricity and Magnetism*" by G. E. H. Gordon, and the well-known standard work on "*Electricity and Magnetism*" by the late Clerk Maxwell. In order thoroughly to study Electricity a knowledge of the Differential Calculus is necessary.

Little books on Electricity do, as a rule, profess to treat the subject by more elementary mathematics; but they do so by unblushingly quoting results derived from the Calculus. It would be better for the student of an elementary book to have nothing whatever placed before him, that he cannot prove by the mathematics of which he is master.

New Books and Reprints.

MATHEMATICS.

- BRABANT (F. G.) The Elements of Plane and Solid Mensuration. With Copious Examples. Cr. 8vo, pp. 280. Rivingtons ... 3/6
- LANGLEY (E. M.) and Phillips (W. S.) The Harpur Euclid. An Edition of Euclid's Elements Revised in Accordance with the Reports of the Cambridge Board of Mathematical Studies, and the Oxford Board of the Faculty of Natural Science. Book 1. Cr. 8vo, pp. 128 Rivingtons ... 1-6
- NEWCOMB (S.) Elements of the Differential and Integral Calculus. 12mo pp. 307, New York ... 9/
- SMITH (J. Hamblin) Key to Exercises in Arithmetic. (Rivington's Mathematical Series) Cr. 8vo, pp. 256 Rivingtons ... 6/6

General Articles.

BARODA CITY SCHOOL.

WE illustrate a design for a school building which is about to be erected by His Highness Sir Sayaji Rao Gaekwar.

The building will face the Swar Sagar Tank in the middle of the city, and is intended to act as an auxiliary to the College which is situated near the Railway Station. The building is intended to accommodate 600 students, and will cost between sixty and seventy thousand rupees. The drawings were prepared by Mr. R. F. Chisholm.

RAI KANHYA LAL BAHADUR, M.I.C.E., LATE EXECUTIVE ENGINEER, P. W. D., PUNJAB.

RAI KANHYA LAL was born in 1829, at a place called Jalesar, a small town situated about 25 miles to the North-West of Agra, in the North-Western Provinces.

In the Government College at Agra, where Kanhya Lal was admitted into the first Persian Class, and where he commenced the study of the English and Nagri languages; in the year 1844, he went rapidly through all the English Classes of the College, and in 6 years obtained a good knowledge of English, besides considerable proficiency in mathematics and physical science, for which he acquired a talent from the very time he began his English studies.

The late Sir George Edmonstone, who examined Kanhya Lal in the last named subject, in the year 1848, remarked in his Report, that Kanhya Lal's answers in that subject were "creditable to him, both in matter and manner."

Kanhya Lal's attainments in mathematics and physical science attracted the attention of Mr. Middleton, Principal of the College, and of Mr. James Thomason, then Lieutenant-Governor of the North-Western Provinces, both of whom, after conferring on Kanhya Lal the first English scholarship of Rs. 40 per month, for general proficiency in English, advised him to go to Rurki, to pursue his studies there, with the view of qualifying himself for employment as Sub-Assistant Civil Engineer on the Ganges or Jumna Canals. Acting in accordance with this advice, Kanhya Lal proceeded to Rurki in 1850, where he went through the whole Course of College studies in the short space of 18 months, and at the annual examination held in December 1851, obtained the first prize in mathematics, first in Engineering studies, first in Geodesy, and first in private studies, together with a Diploma of qualification in Civil Engineering, and was appointed a Sub-Assistant Civil Engineer on the Eastern Jumna Canal at Saharanpur, on a salary of Rs. 100 a month. Colonel (now Lord) Napier, then Civil Engineer in the Punjab, had at that time applied to Colonel Cautley for the services of a well qualified Native Assistant Civil Engineer, and Kanhya Lal was, in 1852, transferred from Saharanpur to the Punjab, where, in the course of 32 years, he has, through his own exertions, risen from the post of Assistant Engineer 3rd Grade, to that of Executive Engineer 1st Grade, which rank he held in the Department of Public Works when he retired in November 1884, when he was receiving Rs. 1,000 a month.

Rai Bahadur Kanhya Lal has, in the course of his career in the Public Works Department, constructed a number of fine public buildings at Lahore, the most important of which are the Katchery, the new College, Mayo Hospital, Medical School, and the new roof of the Montgomery Hall, and has also executed several roads, with a number of good timber and masonry bridges on them.

He has written several useful books and papers, for the benefit of his countrymen, and the public generally.

In 1868 the Government of India conferred on Kanhya Lal the title of "Rai" as a personal distinction, together with a Khillat of the value of Rs. 500 and a Sanad.

In 1876 the title of "Bahadur" was added to that of "Rai" in recognition of his further services.

His acceptance of the enhanced allowance as Executive Engineer 1st Grade precluded him from promotion to the rank of Superintending Engineer. He was the first of all the Engineers, trained at Rurki, in the Executive Grade.

His subsequent public services call for no remark as they are too recent and well known for comment.

He has always been a supporter of this Journal and a frequent contributor to its columns, and was always eager and zealous to promote the best interests of the Profession to which he belonged.

IRRIGATION IN THE MERV OASIS.

IN the *Pioneer* of the 15th February 1888 the letter from the camp of the Boundary Commission contains the following:—

"He (Prince Dondukoff) also gave us an account of his recent visit to Merv and told us what a rich country it was going to become. He had been to Band-i-Sultan himself, and told us that the remains of the old dam across the river Murghab there were still to be seen, and the old canal taking off from it could still be traced along either bank. The estimates for the re-building of this dam had now been completed and sanctioned and when done the large tract of country to be irrigated from it would enable all the cotton required for Russia to be grown at home instead of being imported from abroad."

In O'Donovan's "Merv" * we find the materials for gauging roughly the value of Prince Dondukoff's expectations.

According to O'Donovan this Oasis has a maximum length of from 50 to 55 miles and a maximum width from East to West of from 35 to 40 miles. As the shape is that of an oval these dimensions do not give a greater area of land than 1,750 square miles or 1,120,000 acres, an area which many of the 31 districts of the Punjab could rival. No Punjab Deputy Commissioner would dream of his district alone growing enough cotton for the whole of an Empire like Russia.

This area depends entirely on the River Murghab for its water supply. The river is dammed up at Benti (this must be the Bandh-i-Sultan of Prince Dondukoff) and at Egriguzar to force water into canals taking off on both banks. Very little water ever passes Egriguzar as the river is lost in the Kaver Kum or black sands 10 miles further on. The Benti bund certainly provides for nine-tenths of the land irrigated.

The Benti dam forces water into the Alasha and Novur Canals. O'Donovan gives the width at water surface of the former as 15.0 feet with side slopes of $\frac{1}{2}$ to 1 (an angle of 60°) and a depth of 8.0 feet of water. The bottom width would therefore be 7.0 feet. He gives the velocity at 3 to 4 miles per hour. The latter would give a surface velocity of nearly 6.0 feet per second. The marly soil described by him could never stand a greater surface velocity than 3.0 feet and probably not stand that even. But even taking the mean velocity as high as 5.0 feet per second, the discharge would only be 440 cubic feet per second. The discharge of the Novur Canal would not exceed 400 cubic feet. The amount utilized at Egriguzar would be one-tenth of these two or 84 cubic feet, and the amount lost in the 10 miles reach below, another 100 cubic feet. The total discharge of the Murgab would therefore not exceed 924 cubic feet. It is highly probable that it does not exceed 500 cubic feet per second.

It would require very good management to get a duty of 100 acres per cubic foot per second in such a climate, so that the Murgab river could not irrigate more than 92,400 acres. It probably cannot irrigate more than 50,000 acres. These are not areas that would add much to the resources of an Empire, and they certainly would not supply even a Province of Russia with all the cotton it wanted.

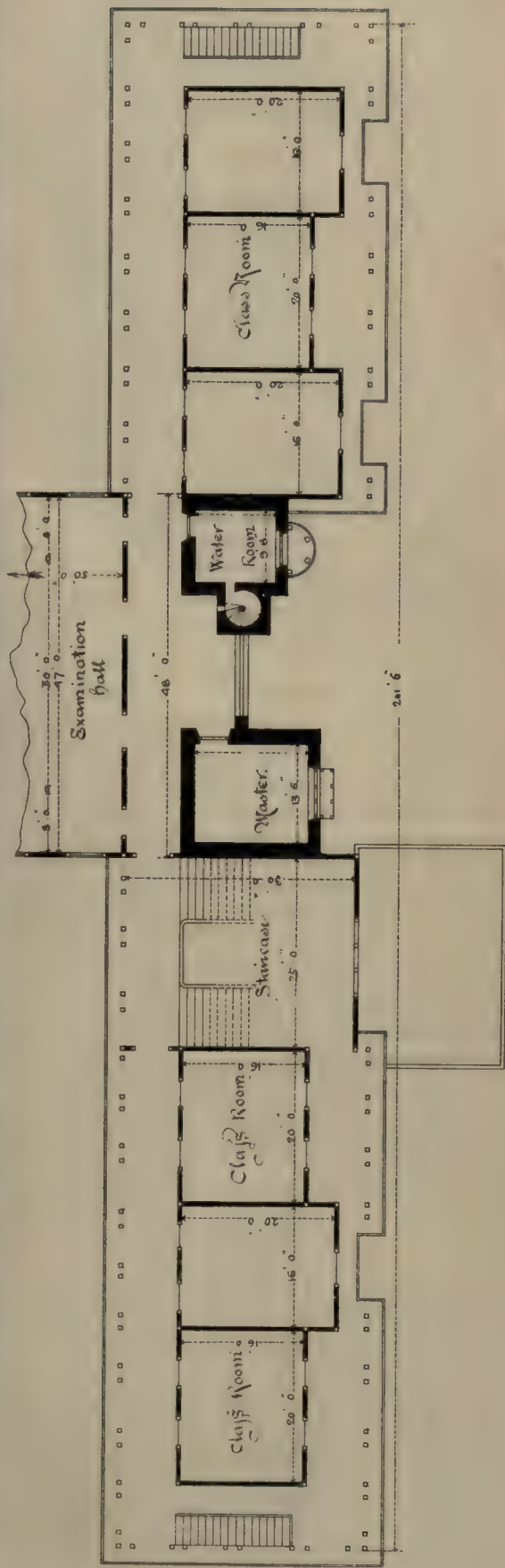
KOREISHI; February 19, 1887.

E. A. S.

* THE MERV OASIS. By Edmond O'Donovan. Vol II.—Chapter XL.

City of London School, late erected, for H. H. the Queen's

R. F. CHISHOLM, P. R. I. S. A. ARCHT.



Scale of feet

10 20 30 40 50 FEET.

THE HAULAGE EXHIBITS AT THE NEWCASTLE EXHIBITION.

THE following errata occur in the first portion of the description of the Haulage Systems, appearing in your issue of 19th November last. In the left-hand column, line 9, for "other pulleys" read "other pulley;" line 28, for "surveying" read "swinging;" line 53, for "curves" read "curve."

8. The Harton Coal Company shew a system of endless rope haulage, in which the rope is carried under the tubs on rollers, and works a road with three rails, with a fourth rail provided at the pass-byes or sidings for the passage of the full and empty tubs. The tubs are attached in setts of about fourteen by clips to the rope, which lies on each side of the central rail. No points or crossings are required in this system, a V piece being placed at each end of the sidings or pass-byes. The sidings or pass-byes are placed at exactly the same distance apart. It is most essential that the setts of tubs should be attached at equal distances along the rope in order to avoid collisions at the sidings or pass-byes, and more especially the clip must not slip upon the rope. This may be prevented by lapping the rope with tarred spun yarn, or better still, by inserting tapered leaden plugs into the rope when partially untwisted. The setts are moved from siding to siding, and pass each other at the pass-byes; the engine is stopped every time the setts reach the pass-byes, an empty sett being taken off and a full sett attached at the in-bye end, and the reverse operation being made at the shaft. It is necessary to attach the setts of tubs *exactly opposite* the part of the rope from which the other sett has been removed. The tubs are attached to the rope by a small clip, one end of which is hooked on to the yoke of the tub, and the other end of which, provided with jaws and a screw, is attached to the rope. This clip passes the bell-shaped sheaves, which carry the ropes round the curve in a very satisfactory manner.

The single roadway systems are chiefly intended to meet the difficulty of maintaining the roads in seams having bad roofs and at the same time affording some of the advantages inherent to the use of an endless rope.

9. The Moresby Coal Company exhibit a variety of the endless rope system devised by their Manager, Mr. James Ramsay. The peculiarity of this application of an endless rope consists of the use of a single roadway for the passage of the setts of tubs moving in opposite directions, the seeming difficulty of the collision of the tubs being overcome by the use of a siding placed about mid-distance along the line. The endless rope is arranged in the figure of ∞ , so that one part of the rope lies in the way and the other rope lies outside the way, both ropes being carried on rollers. When the rope is in motion, the two parts of the rope lying in the way move towards or from the central siding, which is situated at the loop of the ∞ . In working this system, the setts of full and empty tubs are attached to the rope by means of clutch bogeys at the shaft and in-bye landing respectively, and when the engine is started they are simultaneously drawn to the siding into which the empty sett of tubs is run whilst the full sett stands on the main road. The bogeys are then disconnected from the ropes, and run forward so as to take hold of the other rope; in this manner the full tubs are attached to the rope which hauled the empty tubs to the siding and *vice versa*. The engine and the direction of the movement of the rope is then reversed, the effect being to draw the full tubs to the shaft, and the empty ones to the landing near the face of the workings. The bogeys are fitted with an ingenious automatic "knock-off" arrangement, the invention of Mr. James Ramsay. The lower jaw, against which the rope is pressed by the action of a screw, turns upon an axis parallel to the rope, and is held in position by the short arm of a lever. When the long arm of the lever is knocked out of its position, the lower jaw falls and releases the rope. The jaw is raised when the lever is restored to the vertical

position. A vertical jointed bar is placed at each end of the sidings, and of the plane, the joint allowing the bogey to pass with the rope in one direction, and "knocks-off" when going the opposite way. Each rope is carried round the curve of *twenty* feet radius upon six steel rollers. Two bogeys are usually placed at each end of a sett of (forty or more) tubs; this enables the tubs to be pushed into sidings, where the ropes would not otherwise be available. This system has been very successfully applied at collieries, where the difficulties of anticlinal and synclinal gradients were unusually severe, accompanied by similar horizontal curves or bends.

10. The Tredeger Coal Company exhibit another application of the endless rope to single road, with sidings placed at equal intervals for the passage of the setts of tubs. The two ropes, placed six inches apart, both lie within the rails, being carried on ground rollers. The ropes are diverted at the pass-byes, one going straight on, and the other is conducted round the siding on several small sheaves. The tubs are attached in setts of 15 to 40 tubs to the rope by means of a bogey carrying a removeable clip, which is suspended from sockets in an iron frame, one pair of sockets being used for the in-going and the other for the out-coming ropes. The setts are worked by run-riders in much the same manner as upon horse roads with sidings. The clips pass very successfully round the curve of 66 feet radius, the outer rope being kept in position by small rollers, and larger rollers being employed for the inner rope. This system was intended to be driven by an electro-motor, which was eventually removed as it was unfitted for the works.

Systems 9 and 10 were driven by means of a very compact hauling engine provided by the Lowca Engineering Company, Limited, of Whitehaven, which proved to be very efficient for the purpose. It consisted of a pair of cylinders working in backward gear, without reversing appliances. The engine was, of course, run only in one direction, but the reversal of the ropes was effected by a pair of cones, either of which could be engaged with the corresponding drum upon the main shaft.

11. The main and tail rope system, which has attained a very high degree of perfection in the North of England, is shewn by the Hetton Coal Company. The exhibit shews the general system of working upon a small scale, the main rope being employed to draw the full tubs from the face, and the tail rope to draw the empty tubs from the shaft to the workings. The main rope lies on rollers between the way, and its length is equal to that of the plane, and the tail rope is carried on rollers at the side of the way, and is double the length of the main rope.

This exhibit was driven by a self-contained double cylinder engine, with a pair of drums upon the second motion, either of which can be put in or out of gear by a clutch arrangement.

M. W. B.

(To be continued.)

PYROGRAPHY.

IN a late number of the *Annales Industrielles* there is an interesting description of an invention which is likely to prove of great value to art decoration. It consists in engraving on board, leather or glass by means of a steel pencil, the point of which is kept at a red heat. The principle of the instrument is similar to that of the Paquelin cauteriser, which is used in surgery. Only by means of a bellows worked separately and a small gasometer this burner can be kept incandescent for an hour or more at a time. It is just as easy to sketch or draw with the pyro-engraver as with pen or pencil. It can be used for drawing a portrait or landscape as well as ornamenting articles of "virtue and bigotry." Pyrography on wood has not the hardness of outline of the ordinary woodcut. At a very small additional cost it can be utilized for ornamentation in the book-binding, cabinet-making and toy-making trades. In short, any substance that can be carbonized or modified in surface by the action of a burner can be marked by this process.

NAGPUR WATER WORKS.

I.

MR. MORRIS, Chief Commissioner, Central Provinces, having determined to provide the city of Nagpur with pure water, had, in 1869, on the staff of the Department, an Engineer well fitted to undertake the necessary surveys and to prepare the designs and estimates. Mr. A. R. Binnie, M. Inst. C.E., was selected by him for this duty, and the latter's designs and estimate received the sanction of the Government of India in April 1870, and the approval of the Secretary of State in the December following.

As the project was a Municipal work, Mr. Binnie left the Department under the sanction of Government, to execute the works he had planned; all were completed by him in 1872. His letter of the 31st October of that year is in fact the Completion Report. Mr. Trotter's audit note annexed to the same shews how creditably and closely Mr. Binnie worked to his estimate. The actual excess being only 0.45 on an outlay of Rs. 3,67,181.

We give the following general description of these water-works as prepared by Mr. Binnie. When this is read, their scope, character and cost, and the results obtained, will, we think, be understood, and the Report of Mr. E. Penny, M. Inst. C.E., the present Executive Engineer, on the working of the scheme, which is to follow, will be clearer when read after these preliminary remarks.

These works, for the supply of Nagpur, a city of about 84,000 inhabitants, have been carried out on the basis of a formerly existing reservoir, which was constructed in the earlier part of this century during the rule of the Bhonsla Dynasty.

The water from the old reservoir, the contents of which was about 80 million cubic feet or 500 million gallons, was formerly conveyed to the city in a masonry pipe nine inches in diameter and about four miles in length. But the old reservoir embankment with its rough masonry face wall, 896 yards in length, and averaging 12 feet in height, having become very leaky and the stone pipe utterly decayed and broken. It was determined by the Chief Commissioner, Mr. Morris, during the drought following the failure of the monsoon of 1868, to take measures to so far enlarge the reservoir at Ambajerry, as to enable it to store a sufficient quantity to compensate for dry years, and to lay down such a pipe as would at all times deliver a supply of 15 gallons per head per day to the people in the city.

In accordance with this decision, plans and estimates were prepared during 1869 which finally received the sanction of the Government of India in April 1870, and active operations were commenced in the following October.

The works to effect the above objects may be enumerated as follows: a puddle trench has been sunk along the line of the old embankment, passing down through it, and the natural ground on which it rests, and three feet into the solid rock; the erection of a puddle wall in this trench up to the level of the top of the raised embankment; the raising of the old embankment to a height of 17 feet 4 inches above its former level; the erection of a siphon outlet with regulating and straining tower, charging well valve and house; the construction of a waste weir, 200 feet in length; laying a main pipe 13 inches in diameter, four miles in length, with distributing pipes in the city of an aggregate length of 7,166 yards, besides a branch pipe to the Central Jail, a distance from the main pipe of 2,224 yards; the whole of which system of piping will work by gravitation and afford a constant supply day and night.

The excavation of the public trench, 1,033 yards in length, having an average depth from the top of the old embankment of 25 feet, was a work of some difficulty, as it was excavated at a time when there was a considerable depth of water in the old reservoir.

From the trench thus formed 1,268,476 cubic feet of earth and rock were removed between the 10th of October

1870 and the 2nd of May 1871; this trench was afterwards filled partly by the puddle wall next to be described, and partly with black cotton soil.

The puddle wall has a top width of 5 feet, and its greatest height is about 48 feet, it increases in thickness at the rate of 2 inches per foot, until at the ground level its average thickness is about 10 feet, from that level to the bottom of the puddle trench it decreases in width to 5 feet. The clay for making the puddle was carted from Sonagaon, a distance of 3 miles, and was worked up into puddle by prison labor—the men, after the clay had been well soaked, kneading it up with their feet. The total quantity of puddle in the embankment is 920,000 cubic feet.

The whole of the old embankment has been raised about 17 feet 4 inches, so as to enable it to retain the water 13 feet 4 inches above its former level, it now forms an embankment 3,280 feet in length, having a top width of 7 feet 6 inches with a back slope of 2 to 1, and a water slope down to the level of the old embankment of $2\frac{1}{2}$ to 1; this latter slope is pitched with hard Basalt stone 1 foot thick.

This work was of a rather difficult and tedious nature and has been the cause of some anxiety, as the water rose on it for the first time during the last monsoon. The reasons for this were two: first the very bad material of which the old embankment was composed, and secondly the uncertainty which always attends the element of old and new earthwork when combined together.

Fortunately only one slip of any kind occurred, and this was confined to the rear or outside slope, and did not affect the water face of the work; it occurred and was repaired at a time when the water was 7 feet 6 inches below its highest level, since which the reservoir has been full to overflowing, and the whole of the embankment has continued to stand well, the average settlement being below the amount that was expected. The total quantity of new earth in the raised portion being about 2,900,000 cubic feet; it was brought up in regular layers, each about 6 to 8 inches in thickness, inclined to and on each side of the puddle wall, each of these layers was watered, trodden and rammed before the next was laid on it so as to secure as far as possible solid and sound work.

The flood waters are discharged when the reservoir is full over a waste weir 200 feet in length, the whole of the excavation for which and the waste water-course was in Nodular Trap Rock. After passing over the sill of the weir the water flows between low converging training walls 120 feet in length to the waste water-course, down which it falls at an inclination of 1 in 40 to the bed of the stream below the embankment.

The water is drawn from the reservoir by means of a cast-iron siphon pipe 2 feet in diameter, and from 1 to $1\frac{1}{2}$ inch in thickness, which passes over the old embankment, and below the level of the new raised portion.

This plan was adopted to avoid the risk which would have attended cutting through the old embankment, and the chances of injury to which the pipe would have been exposed if laid beneath it.

The siphon pipe, 184 feet in length, has an extreme rise of 15 feet 6 inches, but it will seldom be required to lift the water more than 9 feet 6 inches, its inner end is placed in the regulating and straining well, and is closed by means of a sluice valve 2 feet in diameter; its outer end terminates in the valve house at the foot of the outer slope of the embankment at which place the water is discharged from it, either for the supply of the city, for irrigation, or for scouring out the straining tower by one of two sluice valves, each 15 inches in diameter.

In the valve house is placed a domed cover, by the removal of which the siphon pipe can be entered at any time for examination, and on the top of this domed cover, when in its normal position is fixed an air valve, so arranged as to prevent air from passing from the main pipe or irrigation outlet up into the siphon.

Arrangements have been made for charging the siphon at its crest by filling it with water when all its end

THE NAGPORE WATER WORKS.

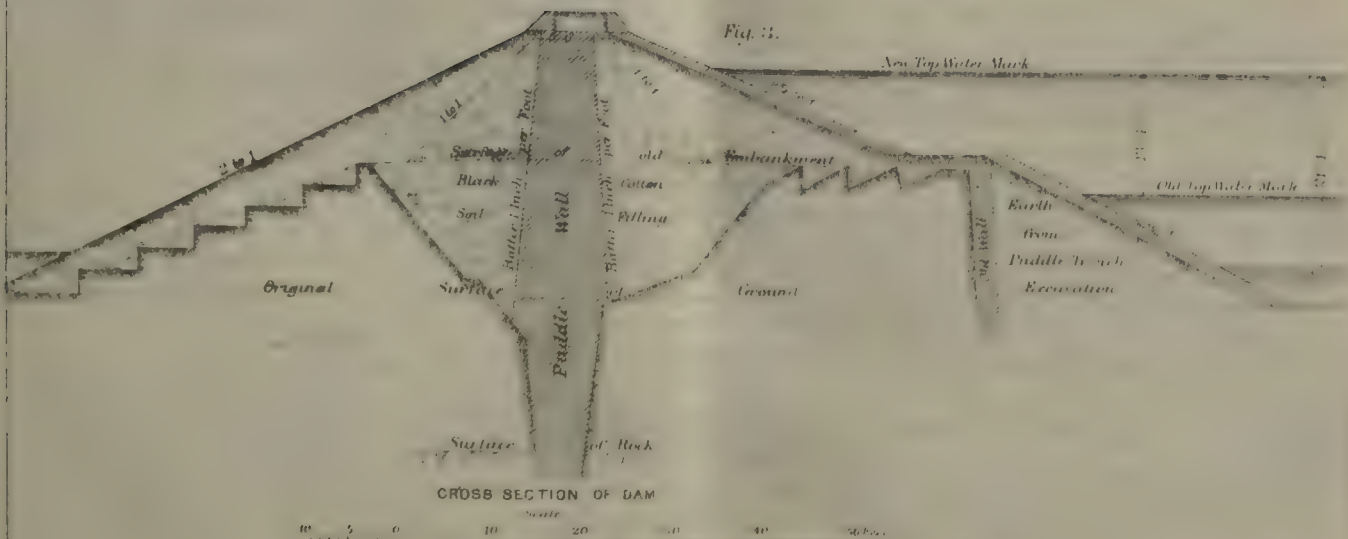
Fig. 1.



Fig. 2.



Fig. 3.



valves are closed; for this purpose it is provided with a short branch 4 inches in diameter, fitted with suitable valves and pipes, which are placed in a proper charging well in the embankment on the outside of the puddle wall.

The laying of the siphon pipes by means of the gantry was an operation requiring much care and attention, on the inside of the embankment they rest on a semi-arch of rubble masonry, and on the outside on a similar semi-arch of concrete; at the point where the siphon pipe crosses the puddle trench, it is supported partly on a masonry pillar, partly on the foundation of the charging well through which it passes, and partly on wrought-iron girders along its whole length, also the pipe rests in sandstone blocks accurately cut and ground to fit it.

The water before passing into the siphon pipe is strained through copper wire gauze strainers, 30 meshes to the inch, in the straining tower. This tower, built of sandstone on basalt rubble foundations, is 48 feet high from the solid rock on which it rests; great difficulty was experienced in obtaining a good foundation in the bottom of the old reservoir, as the excavation had to be carried down 12 feet below its bed at a time when it contained a good deal of water.

The water is admitted into the straining tower through one of three cast-iron sluice gates 2 feet square, according to the height of water in the reservoir; these sluices sliding on proper brass faces are raised or lowered by means of draw-rods and screws placed in the three cast-iron pillars.

The tower is approached from the embankment by a small wrought-iron foot bridge, 80 feet long and 3 feet 6 inches deep, resting at its centre on a small masonry pillar.

The main and city distribution pipes weighing about 1,240 tons are all fitted with proper scouring and air valves, the latter of a pattern which allows of their being used as fire cocks, from which water can be drawn under pressure to extinguish fires, or water roads and so arranged as not to require the use of fire engines.

The public supply of water is afforded by means of standard self-closing drinking pillars, placed at distances apart of about 100 yards, and connection has also been made with some of the old cisterns of the former works.

The supply of water is obtained from the drainage area of the river Nag 4,224 acres or 6.6 square miles in extent, which with an average rainfall of 41 inches will fill the reservoir, or in other words, give a supply of 240 million cubic feet or 1,500 million gallons, sufficient for two years' consumption for the city, including allowance for evaporation. It was proposed to use a portion of this surplus for irrigation, and at present the matter is under consideration.

The purity of the water has been tested, and it is found to be best in the neighbourhood of Nagpur, this is no doubt due to the bare uncultivated nature of the drainage area.

The amount of the original estimate prepared in 1869 was Rs. 3,65,543, and the works then designed have been executed at a cost of Rs. 3,67,181, or within Rs. 1,638 of the estimated amount; but during construction other works not then contemplated have been carried out, which will bring the total cost up to Rs. 3,95,320; this represents a sum of Rs. 4, annas 11, and pies 8, per head of the population, or Rs. 3,15,000 per million gallons supplied per day.

(To be continued.)

PROPERTIES OF FLUIDS.

By A. EWBANK.

IV.

WE originally defined a fluid as a substance that was indifferent to shape. A mass of fluid at a given time must have some particular shape. An alteration in this shape implies the action either of internal forces or of external forces. If we suppose the substance homogeneous, *i.e.*, consisting throughout of molecules which are all alike, and if we consider the substance as persisting in the same shape and volume for a small finite time—say for one minute—then the substance will continue to retain that shape and volume for a longer time unless some change takes place in the external conditions. The external conditions would for instance be changed if we surround the fluid with warmer air than it had originally around it. We will for the present presuppose that there is no internal force which can grow independent of external conditions. Then if the body changes its shape or volume the cause must be some external force.

As regards change of volume no substance is incapable of such a change. But there are substances in which only small changes of volume can be wrought even by the action of very great forces. Liquids generally are thus only slightly compressible and water is one such liquid. On a rigid body we can imagine either tensions or pressures applied. Tensions might elongate a rigid body. Pressure might cause it to contract.

But with fluids we will only consider pressures to act. For tensions, or pulling-asunder forces, would, if sufficiently great, *i.e.*, moderately great, separate the fluid into disconnected portions, and we at present are considering only the behaviour of a fluid when it has all its particles kept together. We mean that the particles are so kept together that it shall be possible to choose any two particles A, B not in contact and to pass from A to B, the journey lying always through other particles of the fluid and never through air or any other substance.

For a fluid thus kept collected the only great external forces that we can admit are great pressures. The tendency of these pressures is to compress the mass—to diminish its volumes—and the mass after slightly accepting compression resists any further loss of volume as long as the pressures themselves do not increase.

Again, if we take a rigid body, such as a bar of cast-iron or a lump of ice, we can make pressure act on it at some particular point A. By a point we here mean a very small area of its surface. Such a pressure would, unless counteracted, induce motion, and therefore if the iron or the ice does not move, we need one or more forces to neutralize the first. Let these new forces act at certain points (*i.e.*, small areas) denoted by B, C, &c. Then we have a body at rest under the action of forces applied at very small portions of the whole external surface.

But we could not treat a fluid in this way. The pressing bodies—the bodies that exert the force—would in such a case easily enter the fluid at the small areas A, B, C, &c. The pressures that we shall employ are not exerted over small areas. They act on the whole extent of the surface. No part of the external surface of a fluid is free from such pressures as we shall employ. The pressures may vary considerably over a surface, but for the present there will absolutely be no single area, however small, at which the pressure is absolutely zero.

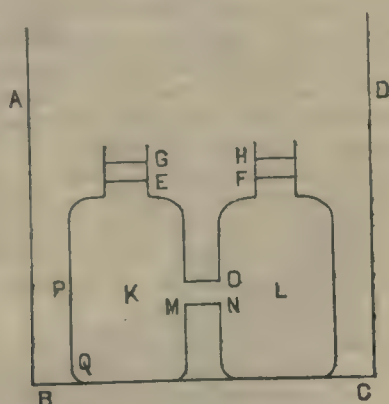
Now, when we say that a fluid will easily alter its shape, we only mean for the present that if all round the mass of fluid certain pressures are applied then the shape of the fluid does really depend on the distribution of these pressures. We mean that if at one place a pressure is lessened or at one place a pressure is increased and the pressures elsewhere are not lessened or increased by the same amount, forthwith the mass of the fluid begins—quickly or slowly, but anyhow decidedly—to alter its shape. We mean that if the alteration of pressure is considerable the ultimate alteration of form will be likewise considerable. We mean that although

WORKING upon the assumption that the Star of Bethlehem was none other than Venus, Mr. John T. Nicolson make this calculation in a recent number of *Nature*:—"That 1180 synodical periods of Venus (*i.e.*, 1180 by 583.92 equal to 689,025 mean solar days) take us back from October 28, 1887—when Venus was at her maximum brilliancy as a morning star—to only May 3 of the year 1 A.D., instead of December 25 of the year 1 B.C. For the number of days from October 28, 1886, to December 25, 1 B.C., is 689,155 (*viz.*, 1887 by 365.2425—689,213—64 plus 6—689,155.) By this showing, Christ was born on May 3 of the year 1."

the alteration of pressure anywhere be as small as we please, there will still be some consequent change of shape. We thus assert that we cannot have a change of pressure so small as not to induce some change of shape. If the body under a considerable change of pressure refuses to change shape to any considerable degree it is not a fluid.

In the case of a fluid any alteration of pressure on the surface causes an alteration of pressure to be felt throughout the mass. This liability to disturbance throughout the mass—this so to say extended sensitiveness—this tendency to a readjustment of the whole form of the fluid—is a feature of fluids to which we will give the name solidarity. The origin of this term we shall a little later on explain. Meanwhile we may prepare another experiment to illustrate this permeating sensibility.

Fig. 6.



In fig. 6 K and L are two vessels preferably of glass. Each should have two orifices. If M, N, represents two of the orifices, the vessels can be arranged, as in fig. 6., with a glass tube O connecting M and N. If the vessels do not happen to have their side orifices at the same height above their bases; one vessel can be placed on a raised stand or a bent glass tube can be fitted. We shall suppose that the O tube is of narrow section, though this is not absolutely necessary. The M, N, orifices may be unequal as corks can be fitted in them, and the tube O fitted in the corks. When the arrangement is completed there is a passage for fluid from one vessel to the other. We may use any fluid we like for the experiment, but water is most convenient.

The passage of water from one vessel to another through the O tube may be detected if the water contains any dust particles floating in it. Or we could colour the water in one tube. But some dust particles, such as carpenter's saw-dust, will answer our purpose. These vessels may stand in an outer vessel ABCD, the use of which will be indicated afterwards. At present we are not concerned with this outer vessel. Let water be poured into one or both vessels. After the water in each is above the level of the tube O each vessel will have the same level for its free surface. Let one vessel have a broad neck and let the other have a narrow neck. Let the water stand at E, F, in the two vessels. Then the water which is in K would issue at M were it not restrained by an external pressure inwards. This pressure is due to the water in L. Similarly the L water would issue at N, were it not prevented by a counter pressure due to the water in K.

Let more water be poured into K. Then there will be a slow passage of water through O. If the level in K rises to G, the level in L will rise equally and will stand at H. If all the water we have thus added had been poured in through the narrow neck of L, and if this water had been poured into L at the same rate as it was poured into K, there would have been a more rapid passage of water from L to K. Suppose we have the sections of the necks as 9 to 1. And suppose we add 10oz. of water in one minute, then in the first case one ounce will pass through the tube in one minute; and in the latter case 9oz. would pass through the tube in one minute. Thus, if we pour in

water at the same rate in each case, the velocities through the tube must be as 9 to 1.

The vessels K, L may be different in shape and volume. But the experimental fact that motion through the tube ceases as soon as the level in K equals that in L shews us that the pressures at M and N do not depend on the whole masses of fluid in K and L, but only in the levels of the free surfaces. There was rest—that is, there was equilibrium when the levels were at E and F. There is equilibrium when the levels are at G and H.

We may therefore consider that the mass of water from E to G is balanced or controlled by the much smaller mass between F and H. This apparent balancing of one body by a much lighter body is called the hydrostatic paradox.

If we add to the K fluid a further small quantity X then a quantity equal to $\frac{1}{10}$ th of X will pass through the tube. This small influx must lift up a much greater mass of water in L, as otherwise there would be no room for the entry of this small quantity $\frac{X}{10}$.

Similarly, an addition of X to the vessel L will manifestly disturb a mass of water above the level of M in the vessel K. It might be thought that this X fluid or the portion of X which enters K has had no action below M. But if we consider any small area Q in the inside surface of the bottle the water there has its pressure outwards—its tendency to burst the bottle—increased.

Such appears to be the case from the following fact. If we have the outer vessel AD filled also with water to the level GH and have a small hole made at Q, there will be no passage of water either outwards or inwards. As soon however as we pour in the X fluid at H, we see that not only does the level rise at G, but water also is forced out at Q and the water in the outer vessel is lifted to as high a level as is the water in K or in L.

NOTES FROM HOME.

(From our own Correspondent.)

At the opening meeting of the year Mr. A. T. Walmisley, the President, read his inaugural address on his first taking the chair of the Society of Engineers. He first reviewed the history of the Society from its commencement in 1854, when it was developed out of the College of Engineers then established down to the present time when it numbers a total of 382 corporate members. The growing use of steel, and the efforts small Engineering works were making to produce their own steel, and the consequent advantages were then noticed. Mr. Walmisley then described the contractors' plant, noticing the decreased use of staging and scaffolding in erection compared with former times, and the increased application of cranes of various new forms to works in progress. Special forms of dredgers, of earth-excavators and of steam navvies were then described as well as the steam and hydraulic plant now found distributed over the manufacturer's yard. The President then entered into the question of water-supply and drainage, and from Mr. Symonds' statistics of rainfall shewed by tabulating the figures, some noteworthy facts connected with the drought of 1887. The effect of the transfer to Municipal and local authorities of various undertakings, which had some years since been executed by private enterprise was pointed out. Steam and Electric traction and the extended use of Cable tramways since their introduction in 1873 into San Francisco and about 1884 at Highgate, were seen to be working well where they had been employed. Hydraulic machinery, as in use at different docks, and for lifts of different kinds, was fully described and the introduction in Birmingham of compressed air as a motive power was expected to produce good results. Increased speed had been attained at sea with financial success by the adoption of triple and quadruple expansion engines in high-class steamers. The necessity of maintaining our coaling stations in working order was also insisted on. The President dwelt upon the future prospects of the profession and of trade; and in conclusion addressed the younger members of the Society, urging that no day should be wasted, as no experience was fruitless.

The works for the new central station of the Metropolitan Police Force on the Thames Embankment, which are intended to supersede the establishment at Scotland Yard, are now in

active progress, a large number of men being employed upon them. The spacious building will almost cover the site until recently occupied by the unfinished Opera House. It covers an area of about 40,000 feet or nearly an acre in extent, having a frontage of upwards of 200 feet to the embankment and extending in depth westwards to Cannon Row, by which the building will be approached as well as by the principal entrance on the embankment. The necessary excavations having been completed, the foundation walls and basement are now in process of construction and the superstructure will shortly be proceeded with. The building is intended to be a lofty and handsome edifice harmonizing in its architectural features with the recently erected structures around it. It is said that the cost of the building including the price paid for the land will amount to £250,000.

The second edition of that practical work on Iron Roofs by Mr. Walmisley contains valuable additions—for instance, there are two plates of the Corn Exchange, Leeds; the Carlisle Corporation Markets; The National Agricultural Hall, Kensington; the Bradford Exchange New Station, and the Norwich Thorpe Station. A metre scale has been added to all the plates. No less than 12 plates have been inserted, shewing graphic method of calculating the strains in 12 different types of roofs, the calculation being fully described in the letterpress. The specification for the iron is given in full for 3 roofs. Then St. Pancras' Station roof is given as an example, shewing tests adopted 20 years ago, and Olympia Kensington is given as a modern example of the "elongation" condition of testing iron under strain, and Carlisle Market as a modern example of the "contraction in area" of testing iron under strain. Tables of roof coverings are added as is also a useful form of agreement for the erection of a structure. The book is dedicated to the President of the Institution of Civil Engineers and published by Spon.

In the 14th Edition of Heather and Walmisley's well-known book on Mathematical Instruments, much obsolete matter has been removed, and many modern instruments, such as the omnimeter, the planimeter, the curve ranger and the traveller's small theodolites introduced. The work is compact and contains as much information as its size will allow. The reviser of the new edition in his preface mentions the useful examinations now periodically conducted by the Surveyors' Institution and the Association of Municipal Engineers.

The supply of water in the reservoirs of the Manchester Water-works and also those of Liverpool have never been so low at this time of the year as they are at the present time, and notices urging precautions against waste are issued by the authorities marking the fear that exists if the present unprecedented need of rain continues.

With respect to the recent gold discovery in Wales, it is stated that ten heads of stamps for crushing the gold have now been erected at Mount Morgan Gold Mine, Dolgelly, North Wales, belonging to Mr. Pritchard Morgan, and operations have been commenced on the gold quartz, the results of which are pronounced to be highly satisfactory.

Notice is given that the fifth examination of candidates for the Offices of Borough Engineer and Local Board Surveyor, and carried out by the Association of Municipal Engineers, is to take place on the 27th and 28th April at the Institution of Civil Engineers, Westminster.

MINING IN GREAT BRITAIN.

MR. MORITZ HONIGMANN (of Grevenberg, near Aachen in Germany) has recently applied his system of fireless locomotives to the work of haulage in mines. The locomotive is 43½ inches wide, 54 inches high, and, including the driver's seat, 137½ inches long. It has four coupled wheels 15½ inches diameter and 18½ inches gauge. It has two cylinders 5½ inches diameter and 7½ inch stroke. It can draw a train of 12 tubs weighing 13½ cwt. each at a speed of about 7 miles per hour. This fireless locomotive is based upon the principle that a solution of caustic soda of certain concentration and boiling point, absorbs steam with the development of heat. The solution of caustic soda is employed to absorb the exhaust steam, and the consequent increase of temperature is employed for the production of fresh high pressure steam. The arrangements for carrying out the system consist of a steam or hot water boiler, from which the steam is taken for driving the engine. The caustic soda boiler (which is filled with a solution of caustic soda) is placed in and about the steam boiler. When the system is in action, the exhaust steam is conducted into the caustic soda boiler and steam is

produced in the hot water boiler as long as the caustic soda continues to absorb the exhaust steam. It will be seen that the production of steam is perfectly automatic, as by increased consumption of steam, increased volumes of exhaust steam are passed into the solution of caustic soda. The process is continued until the solution is diluted to a boiling point of 166° centigrade, corresponding to a steam pressure of about 6 atmospheres. When this limit of working is reached, high pressure steam is passed from a stationary boiler into a series of coiled tubes in the boiler containing the solution of caustic soda, which is evaporated down to a degree of concentration corresponding to a boiling point from 185° to 210° centigrade and pressure from 10 to 17 atmospheres. As soon as this operation is completed and additional hot water placed in the hot water boiler, the engine is ready again for use.

A discovery has been made of a valuable deposit of alabaster at St. Bees' in Cumberland. It is being used for the manufacture of a cement which is usefully employed for many purposes. It can be applied as plaster in any weather and speedily dries and hardens. It is readily moulded and easily cleaned. It bears a tensile strain nearly double that of Portland cement. It is fireproof and paint is readily applied to it.

An important modification has been recently introduced in the construction of the well known Marsaut safety lamp. It consists in arranging for the removal of the gauges by unscrewing the shield and thus avoiding the continual removal of the glass from the cage provided for its reception. Except when taken to pieces for repairs, the lamp consists of only five parts:—the oil vessel; the cage containing the glass, which is cleaned without removal; the upper shield; and the two gauges. The lamp is provided with Ryder's patent pillar lock, by which the cage, the oil vessel and the shield are simultaneously locked after being screwed together in the usual way.

Attempts are being made by mining engineers to utilize firedamp in mines. A blower at the Merthyr Vale colliery in South Wales has been piped to bank, and is being employed to fire three boilers. This is turning an enemy to a valuable purpose, as the saving of coal may be estimated as at least about 100 tons per week. Similar arrangements are being made at a Durham colliery to utilize large blowers of gas which has been wasting for some years. Natural gas is now employed at many collieries and makes a fair illuminating gas, especially if passed through any volatile hydrocarbon oil. These experiments in the use of firedamp as fuel are being watched with great interest.

Experiments are being conducted at Marsden near South Shields on the observation of earth tremors. An interesting feature of the records is their apparent connection with disturbances observed at other and distant places. The shocks experienced at St. Louis, U. S., on 7th February, at Nice and adjacent districts during the latter part of February and beginning of March, in Bohemia and Burma on 14th March, appear to be recorded by the instruments in use at Marsden. It may be mentioned as a curious coincidence that the disturbances experienced at Marsden on 6th and 8th December 1886 were closely followed by the issue of increased volumes of explosive gas at many of the adjacent collieries.

The use of lime containing notable proportions of magnesia should be avoided in all engineering operations. Walls built with it actually grow, and instances have occurred in the case of engine foundations, in which one of the foundations (built with such a lime) has increased six inches in height. In another case of supposed sinking of ground, based upon observations of an adjacent chimney, it was found to have increased about one foot in height. Notable increases of the height of the surface have occurred in the case of depressions which have been filled in with the spent lime of gasworks. The same growth has been observed in dwelling-houses whose openings for the insertion of doors and windows have increased notably in height in the course of 10 or 15 years. The maximum rate of growth observed is at the rate of about .1 per cent. per annum, and the growth continues for at least 20 years.

A great amount of interest is being evinced as to the discovery and profitable working of gold ores in Merionethshire. The discovery is by no means a new one and the hill-sides are still strewn with buildings and other evidence that the operations previously prosecuted have resulted in financial loss to the adventurers. It is possible, however that success may now be achieved in the case of some of the

gold bearing veins, if the mining be conducted with economy, and suitable machinery be employed for recovering the gold, which is most refractory of reduction. It is most important that competent persons only should be appointed to the mill. Cases have occurred in which the persons selected have been totally inexperienced in the working of the plant, and did not know to separate the gold from the amalgam, or even how to apply the mercury to the copper plates. No one need be astonished in such cases that ruin and failure follows as the result of the employment of such amateur gold mining engineers.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Madras, February 28, 1888.

The following intimation, received from the Secretary of State, is published:—Major D. McNeil Campbell, R. E., Executive Engineer, 1st grade, Madras. Furlough extended to two years.

Punjab, March 1, 1888.

His Honor the Lieutenant-Governor is pleased to sanction the following promotions and reversions in the Amalgamated Engineer Establishment of the General and Irrigation Branches of the Public Works Department, Punjab, with effect from the dates specified against each:—

Mr. H. W. V. Colebrook, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, *vice* Mr. Farrant on deputation with effect from 28th March 1887.

Mr. R. Sadler, Executive Engineer 3rd grade, to be Executive Engineer, 2nd grade sub *pro tem.* *vice* Mr. Colebrook whose promotion is antedated, with effect from 9th August 1887.

Mr. R. Sadler, Executive Engineer, 2nd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, on Mr. Smallman's return from deputation, with effect from 30th October 1887.

Mr. F. W. Chanter, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, on Mr. Smallman's return from deputation, with effect from 30th October 1887.

Mr. A. Hicks, Executive Engineer, 4th grade, sub. *pro tem.*, to be Assistant Engineer, 1st grade, on Mr. Smallman's return from deputation, with effect from 30th October 1887.

Mr. R. Sadler, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, *vice* Mr. Field, on deputation, with effect from 6th November 1887.

Mr. W. Smith, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, *vice* Mr. Field, on deputation, with effect from 6th November 1887.

Mr. A. Hicks, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, sub. *pro tem.*, *vice* Mr. Field, on deputation, with effect from 6th November 1887.

This cancels the promotion of Mr. Colebrook as notified in Notification dated 19th September 1887.

Mr. A. C. L. Learmouth, Executive Engineer, 3rd grade, temporarily attached to the Simla Imperial Circle, is granted furlough for 18 months, with effect from the 1st April 1888, or such subsequent date as he may avail himself of it.

Irrigation Branch.

With reference to Government of India, Public Works Department, Notification, dated 31st January 1888, Mr. G. M. R. Field, Executive Engineer, 2nd grade, and Mr. C. J. O'Brien, Assistant Engineer, 1st grade, who have been temporarily transferred to the Patiala State left the Irrigation Branch, Punjab, on the forenoon of 6th November 1887, and forenoon of 20th October 1887, respectively.

Bombay, March 1, 1888.

The following Notifications by the Joint Secretary to Government, Public Works Department (Railway), are published for information:—

Furlough for six months from 1st April 1888, or from such subsequent date as he may avail himself of the leave, is granted to Mr. W. Harvey, Executive Engineer, 1st grade, Rajputana-Malwa Railway.

Furlough for eight months from 1st April 1888, or from such subsequent date as he may avail himself of the leave, is granted to Mr. H.E. Haddon, Executive Engineer, 4th grade, sub *pro tem.*, Rajputana-Malwa Railway.

Central Provinces, March 3, 1888.

Mr. G. G. White, Executive Engineer, Kanhan Division, availed himself of the privilege leave granted to him in Central Provinces Notification, dated 14th February 1888, making over charge of his duties to Mr. G. M. Harriott, Executive Engineer, on the afternoon of the 21st idem.

Mr. W. Donkin, Assistant Mining Engineer, Warora Colliery, reported his return to duty on the forenoon of the 12th ultimo, from the privilege leave granted to him by Notification dated 8th December last.

N. W. P. and Oudh, March 3, 1888.

Buildings and Roads Branch.

Mr. W. P. Houseden, Assistant Engineer, 1st grade, is, on

return from England, posted to the 1st Circle, Provincial Public Works, for duty in the Agra Division.

India, March 3, 1888.

The following reversions will take place in the Local Administration list, with effect from 1st February:—

From Executive Engineer, 2nd grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, permanent:—

Mr. J. C. Rees.

" E. Penny.

Mr. F. J. E. Spring, Executive Engineer, 2nd grade, State Railways, is transferred from the Establishment under the Government of Bengal to that under the Director-General of Railways.

Military Works Department.

Lieutenant F. H. Oldfield, R.E., Assistant Engineer, 1st grade, held charge of the current duties of the Office of the Executive Engineer, 1st Pishin Division, Military Works, in addition to his own duties from the 18th August to the 8th September, 1887, inclusive.

Bengal, March 7, 1888.

Establishment—General

Mr. J. C. WHITE, Executive Engineer of the Darjiling Division, is appointed to hold charge of the temporary Kalimpong Division.

Mr. H. H. Green, Assistant Engineer, is appointed to officiate as Executive Engineer of the Darjiling Division during Mr. White's absence, or until the further orders.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 29th February 1888.

162 of '87.—Minden Hardress Mackenzie, Indigo Planter of Doo-riah, Tirhoot, in the Presidency of Bengal.—*For an improved wheel for carts and other vehicles, and for improvements in the construction thereof.*

163 of '87.—Cecil Noble and Hubert Haes, of 3, Newman Mews, Newman Street, Oxford Street, London, in the County of Middlesex, England, Engineers, and George Lenton Roff, of 32, Norfolk Street, Strand, London, aforesaid, Civil Engineer.—*For a new or improved sewing-machine.*

166 of '87.—Alexander Parkes, of 8, Chancellor Road, Dulwich, in the County of Surrey, England, Gentleman.—*For improvements in extracting gold, silver, and other metals from ores or compounds containing the same.*

168 of '87.—Francis Rinecker, of Wurzburg, Germany, Civil Engineer, and Roman Abt, of Lucerne, Switzerland, Civil Engineer.—*For improved rack and pinion mechanism for rack railways.*

207 of '87.—William Jackson, Engineer, Thorn Grove, Mansfield, Aberdeen, Scotland, North Britain.—*For improvements in, or connected with, machines for rolling tea leaf.*

33 of '88.—Amos Herbert Hobson, of 5, Westminster Chambers, Victoria Street, in the City of Westminster, England, Analytical Chemist.—*For improvements in apparatus for heating air for desiccating and heating purposes.*

Advertisements.

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CONTRACTORS to take a whole or part of the cutting of the Coal in the Umaria Colliery. Natives or Eurasians preferred.

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UMARIA *via* KATNI,
2nd March 1888. }

Patiala-Bhatinda Railway.

Applicants for employment as Upper and Lower Subordinates are informed that vacancies are all filled.

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Mymensingh District Board Notice.

WANTED a competent Overseer. Salary Rs. 100 per month, including travelling allowance for two months at present. The candidate should possess the certificate of an Overseer, Public Works Department, with two years' practical training. Certificate from his last superior officer is indispensable.

Applications, with copies of testimonials, will be received up to 26th March 1888.

HERAMBO NATH DASS,
DISTRICT ENGINEER.

MYMENSINGH, 3rd March 1888.

NOTICE.

WANTED for the Office of the Inspector of Local Works, Bhagulpore Division, a Second Clerk, Draftsman, and Estimator on Rs. 60 per month.

Applications, with copies of testimonials and specimens of drawing (which will not be returned) will be received up to 31st March 1888. Unsuccessful candidates will not be answered.

W. H. NIGHTINGALE,
INSPECTOR OF LOCAL WORKS,
Bhagulpore Division.

BHAGULPORE, 5th March 1888.

NOTICE.

ALLAHABAD MUNICIPAL BOARD.

WITH reference to the advertisement calling for Plan and Estimate for a Municipal Hall for this City, notice is hereby given that the Board do not wish to tie down competitors to the actual sizes of the rooms therein given as long as their areas are not decreased.

By order,

T. R. EDMONSON.

Secretary, Municipal Board, Allahabad.

ALLAHABAD, 20th February 1888.

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None, but a first class man who has been employed in this business need apply.

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LAHORE.

(81)

TO BE SOLD.

BY Public Auction to the Highest Bidder on Monday, the 19th day of March 1888.

BY

Messrs. MACKENZIE LYALL & CO.

Under instructions from Baboo Ramkissen, the Official Liquidator of the Imperial Ice Company, Limited, under an order for that purpose obtained by him from the High Court, dated the 23rd day of February last, at the Company's Ice Factory at Bhowanipore aforesaid, the whole of the machinery and plant of the said Imperial Ice Company, Limited, (viz) .—

Valuable Ice-making Machines together with Pumps, Tanks and other necessities for carrying on an Ice Industry.

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The whole of the machines are in first-class condition. Portions of these have been in use for three years and portions for two years and that even not constantly.

For further particulars and conditions of sale apply to Baboo Ramkissen, the Official Liquidator, at No. 23, Strand Road, or to his Attorney, G. Gregory, No. 11, Old Post Office Street, Calcutta.

IMPORTANT SALE

OF

Valuable Leasehold Property in Bombay.

Preliminary Announcement.

To be sold by Public Auction, on a day to be hereafter fixed (unless a suitable offer is previously obtained by Private Contract) by order of the Mortgagee and on account and risk of the Official Assignee as the Assignee of the estate and effects of James Donald of Bombay, the whole of the valuable property known as the Ripon Iron Works, situate at Frere Road, Bombay, with all the machinery and fittings used in connection therewith.

For further particulars and conditions of sale apply to the Undersigned, Solicitors to the Mortgagee.

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THE Acting Agent will be prepared to receive at his Office, Victoria Terminus, Bombay, up to 1 P.M. (Gunfire) on Wednesday, the 28th proximo, Tenders for the purchase of the following old Rails double headed Section 68lbs. to 85lbs. per yard.

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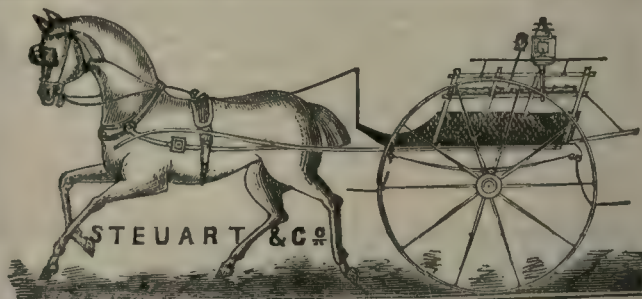
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The same are now lying on the Company's premises Wari Bunder, Mazagon, Bombay, and may be viewed on application to the Wharf Superintendent.

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Delivery will be made by the Company into Barges to be provided and placed by the purchaser alongside the Wharf. Payment must be made at the time of delivery.

The Acting Agent reserves the right to reject any or all of the Tenders.
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(70) 20th February 1888. } **ALFRED KING,**
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Obituary.

- GRANT.—On 2nd March, at Roorkee, Lieutenant J. Grant, Bengal Sappers and Miners, aged 50 years.
- GRANT.—At Soory, on the 8th March, of inflammation of the lungs, James Henry Grant, M.I.M.E., District Engineer, Birbhoom.

EDITORIAL ANNOUNCEMENT.

Several Letters and Articles are held over for want of space.

INDIAN ENGINEERING.

SATURDAY, MARCH 17, 1888.

AN APPEAL
TO THE PROFESSION IN INDIA.

It is due as much to ourselves as to our constituents to make known, once more, that this Journal receives no help whatsoever from Government.

INDIAN ENGINEERING is not a "Trade" speculation. It was started at the request of the Profession; is owned and conducted by a member of the Profession; and is exclusively devoted to the interests of the Profession.

The result achieved so far shows that the Profession in India is capable, willing and able, to maintain an organ of its own.

The Journal is published at a figure that just suffices to pay its way; and it is an unquestionable fact that the rate of subscription—viz., RUPEES TWELVE per annum, including postage—is the lowest possible for an ILLUSTRATED Weekly publication of its class, anywhere, but more especially in this country. It is, however, only fair to the Profession to state that frequent suggestions have been received favoring enhancement, and some of these expressed opinions have come from those best qualified, by status and experience, to pronounce on the subject.

Notwithstanding all this, the Journal has never sought State aid or a Government subsidy. It has not asked for an Official guarantee re its circulation. All that it needs is a fair field and no favor. It is content—in this age of competition—to stand or fall on its own merits, and is willing to leave that issue in the hands of the Profession.

ANOTHER JOB.

WE understand it is under contemplation by the Government of Madras to transfer Captain Lindley, R.E., from the grade of 1st Assistant to that of 3rd Executive. On examining the Madras list we find that Captain Lindley joined the P. W. D. in February 1885, and was graded as 1st Assistant in accordance with the rules regulating the admission of R. E. officers. The greater part of his service since 1885 has been spent either on leave or on military duty, so that he has no exceptionally brilliant civil record to entitle him to promotion out of his turn. The proposed action of the Madras Government thus savors strongly of nepotism, and as the promotion of the junior members on the Madras list has been, and promises to be, exceptionally slow, we cannot avoid protesting against it. We trust that our protest may have the effect of opening the eyes of those in authority to the effect of the piece of favoritism that is contemplated, and of stopping it. If not, we can only recommend all Civil Engineers on the Madras list, who would be affected by Captain Lindley's promotion, to individually memorialise the Secretary of State on the subject. The Civil Engineers now occupy so strong a position in the service that a protest, if properly worded and promptly submitted, would not fail to have the desired effect.

THE BEHEEA SUGAR MILL IN COURT.

THE decision of the High Court in *re* the Beheea Sugar Mill deserves more than a passing notice. In one sense it is of a wider application than the conventionalities of a lawsuit, and independent of the question of patents while on the other the principle involved is of some importance from a legal point of view. But a singular phase of it is, that within the last four or five years two attempts have been made to have an injunction issued by the High Court, calling upon Messrs. Thompson and Mylne, of Beheea, on the East Indian Railway line, to show cause why the Court should not declare that they had not acquired any exclusive privilege in respect of an alleged invention or new application of simple and cheap machinery for expressing sugarcane juice, described in a certain specification, dated the 28th of June 1874, and an amended specification of the 18th March 1882; and why any pretended or asserted exclusive privilege acquired by them should not be revoked on the grounds: (1) that the alleged invention was not a new invention within the meaning of the Patent Act of 1859; (2) that Messrs. Thompson and Mylne were not the true inventors; and (3) that their petition and declaration of the 6th January 1874, and subsequent petition and declaration of the 4th November 1881, relating to the said alleged invention, and the original and amended specification and declaration contained wilful and fraudulent mis-statements. In both instances the rule was discharged. On a third occasion, when the proprietors of the patent prayed the High Court that a writ of a perpetual injunction be awarded against certain defendants, during the continuance of the plaintiffs' exclusive privileges, from manufacturing or selling the said patent Messrs. Thompson and Mylne not only obtained the writ, but also heavy damages. The tendency of all these decisions has been to recognise the rights of the patentees to the mill and to confer absolute property in them. But a curious circumstance connected with the decision referred to in the opening paragraph of this article is, that Mr. Neil Fox, who is a licensee of the defendants for the sale of the mills, came forward to dispute their rights. His status precluded any chance of success, as, on his own admission, having acted as their agent, he was 'estopped' as the legal phrase goes, from challenging the merits of the patent. The Judges naturally suspected that there was somebody behind the scenes, and their surmise was correct.

One David Hay Ralph Moses, a coolie contractor at Benares, appears to have supplied the sinews of war to Mr. Fox, but not from disinterested motives. In this connection the remarks of Mr. Woodroffe, counsel for the defendants, might be quoted as apposite and to the point. He said:—"Various persons might be found among the tribes of Israel to come in and put their names to a petition entitling them, *ad libitum*, in the matter of Moses, Aaron, or the prophets, and claim rights to investigate the matter." At first Mr. Moses' counsel represented that his client could nowhere be found, but subsequently he turned up, and on examination admitted he had an

object in financing the lawsuit. At this stage of the proceedings it oozed out that about two years ago he took great interest in, and was desirous of introducing into the market, a sugar mill made by one Rogers, an Engineer on the Oudh and Rohilkund Railway. But owing to the patent taken out by Messrs. Thompson and Mylne it was kept out of the market. The witness did not pretend to know what recommendations Rogers' mill possessed, in fact, he had not seen it, but the object of those who meant to play this game was evidently to crush the Beheea Sugar Mill under any circumstances. Mr. Fox came to the rescue and explained to Mr. Moses what virtues Rogers' patent possessed. On being satisfied on these points he advanced Rs. 1,000 to Mr. Fox on account of costs, and on the mutual understanding—a very pleasant one indeed, considering that the chickens were counted before they were hatched—that after the legal proceedings terminated the self-constituted firm of Fox, Moses and Rogers should square accounts, equally dividing the costs among them. Apparently they were not so hopeful of success, or they might have divided in anticipation the profits among themselves. The well-laid plans of man and mice 'gang oft agee,' and in this instance they had counted without the host. As we have said above the counsel for the defendants took up a strong position as regards the right of the licensee to dispute the soundness of a patent taken out by the principal, and during its continuance; besides, the name of Moses could not be used as a stalking horse. The learned lawyer for the petitioner contended that Moses had the same right in the matter as any other member of the community, and also a special interest, inasmuch as there were other sugar mills which he wished to push forward, but which, as the truth must be told, were prevented from being used by reason of this patent. We are no lawyers, but if common sense claimed a place in determining the point we should say, that Mr. Moses might use the same argument in proceeding against any one of the sugar mills in which he was previously interested, because it served a subsequent purpose to follow a conflicting line of policy. With regard to the moral aspect of the argument that, "although in an action for royalties contracted to be paid under a license, the licensee could not dispute the patent, having had the benefit of the consideration, yet there was no authority to the effect that he could not take proceedings to set aside the patent altogether as a fraud on the public," the less said the better. Of the three objections taken by the defendants, the first, *viz.*, that the matter is *res judicata*, or, shorn of its legal phraseology, the subject had once before been decided in their favour, and the third, that the application was barred by limitation, were not taken into consideration by the Court, as it was of opinion that much could be said on either side; it was therefore on the second point, *viz.*, whether his status as licensee precluded his following out the contention, and which we have seen was decided in favor of the patentees. Now the question is, and as the Judges very properly remarked, why all this heavy expense and the loss of time consequent on the inquiry, since within a very few weeks

of the hearing of the suit the right to the specification will expire with the lapse of time—14 years—unless there was an application for the renewal of the patent, which the proprietors have placed on record they are not inclined to do. It is quite apparent that they are prepared with another scheme, an improvement on the present arrangement, which will secure to their mill the same popularity it has enjoyed during the last ten or twelve years.

THE MADRAS ADMINISTRATION REPORT FOR 1886-87.

II.

THE total value of the sea-borne trade of the Madras Presidency in 1886-87 was 23 crores and 2½ lakhs of rupees, representing an advance of one crore and 67 lakhs on the preceding year's operations. The increase was mainly in the trade with the United Kingdom. It is a most satisfactory feature in the detail of this increase that exports of Indian produce and manufactures contributed over 88 lakhs, or 8.03 per cent. towards it. If India *must* be saddled with exorbitant home charges it is only by multiplication of her export trade that she can hope in any sound and solvent way to sustain the burden. But metallic, or any other currency juggles with silver and helpless figures cannot help her need: at best can only stave off the evil day of reckoning. The moral is, and it is a moral that cannot be too much or too often insisted on, that Indian Railway systems should be developed, in order to the efficient development of trade.

The Report declares that there are no mines of importance in the Madras Presidency. Sir Roper Lethbridge is of a different opinion and deems the Mysore gold-fields a very El-dorado. Proof of his conviction he has given by investing in them largely, and Sir Roper is generally supposed to be pre-eminently a man who knows on which side his bread is buttered. Again, the Report concedes that iron mines are worked to some extent by natives, and that quarriers of stone and grubbers of gravel realized the not altogether contemptible sum of Rs. 7,46,000.

The chief agricultural events of the year were Agricultural Shows at Gooty and Erode, and a travelling show of farm implements in the South Arcot, Tanjore, Trichinopoly, Madura, and Tinnevely districts. This latter consisted in demonstrations of the working of improved ploughs and machinery. The results were so encouraging that it has been decided to keep such shows going, in lieu of ploughing matches and plough trials. This seems to us a practical and commendable new departure: we should like to see other parts of India following the example thus set. Improved ploughs and sugar mills are said to be gradually winning their way to favour with the Madras agriculturists.

The working of the Forest Department for 1886-87 was, as usual, financially successful, and showed a net surplus of Rs. 91,096. Unfortunately, the people who live in the neighbourhood of forest reserves have not yet got reconciled to the restrictions imposed by the Department, and consider themselves aggrieved because they

are not allowed to waste and spoil the country's timber supplies as aforetime they wantonly used to. *Apropos* a drama was represented in Madras last year (*Aranyarodana Natak*) expressly devoted to exposition of the grievances of people who imagine that they are defrauded of immemorial rights by the operations of the Department. Parochial interests are often opposed to the well-being of the public at large; but it is too late in the day to think of subordinating to ignorantly selfish whims the proven worth of the philosophical axiom that enjoins consideration for the greatest happiness of the greatest number. The chief work of the Madras Forest Department in the year 1886-87 was selection and settlement of forest reserves. New rates of seigniorage on timber and other forest produce came into force, and special rules were passed for the regulation of hunting and fishing in the Nilgiri reserved forests, and for the transit of timber from the forests of Bhadrachalam and Rékapalle taluks in the Godavéri district. The area of reserved forest in the Northern Circle was increased from 6,552 acres, or 102 square miles, to 303,390 acres, or 474 square miles. The forest area over which attempt was made at protection from fire was 747,758 acres; and of this area 650,064 acres were actually preserved. The cost of protection per acre was 3.5 pies. In all districts except Nellore and Vizagapatam the work of demarcation proceeded well; 1,190 miles altogether being accounted for. To the Southern Circle there were added during the year under review 285 square miles of reserved forest, and 152 square miles of reserved lands. This brings the total up to 2,119 square miles of reserved forests, 3,655 square miles of reserved land, 1,099 square miles of "other forests," 6,873 square miles in all. A respectable total, which brings home to one's mind a sense of the magnitude of the Forest Department's operations. Natural reproduction was favorably reported on in the protected areas.

The tale the Madras Emigration Agency has to tell of its operations is far from satisfactory. No man or woman went to seek fortune in British Guiana. Of 1,266 professedly would-be emigrants admitted into the Mauritius depôt only 747 actually sailed for that destination. Of 779 contracted for Natal but 496 started. Of 32 who returned thence most were invalid paupers. There was a great decrease in the number of emigrants registered for Ceylon. There was no emigration to any of the French Colonies. Ninety deaths at sea took place on board the *Hereford*, bringing back 905 emigrants from Martinique. The rate of mortality amongst emigrants returning from Guadeloupe was still higher, *viz.*, 15 per cent. The amount of savings declared by returned emigrants from the French Colonies aggregated Rs. 98,554. Nearly three-fourths of this sum belonged to the Cayenne emigrants, 443 in number, who are described as having been, with very few exceptions, "the very picture of prosperity." The Straits Settlements seem to be the only field tempting Madrasses to exile now-a-days. 18,495 adults and 2,130 children left Negapatam for that field of labor. *Apropos* of emigration, the money value of the wages paid to agricultural laborers—they are usually paid in kind—

is set down as varying from Rs. 2-5-4 a month in Salem to Rs. 7-8-0 a month in Cuddapah, Coimbatore, and South Canara. The wages of skilled artisans, such as masons, carpenters and blacksmiths, varied from Rs. 11 to Rs. 15 in fifteen districts; and from Rs. 15 to Rs. 20 in six others.

In the chapter of the Report dealing with Education we are told that the Report of the B. Sc. Committee of the Madras University was adopted by the Senate, but that the scheme therein advocated has not yet been matured, "the Committee having been enlarged to report on certain matters of detail." Were these said matters of detail connected perchance with the deliberations of the Committee appointed to ordain suitable costumes for the L. T. and B. Sc. degrees and to consider the suitability or the reverse of the Academical dress now prescribed for graduates of the University? Did gimcrackery of tailoring and tassels absorb all attention, and relegate to the background matters of real moment? We note that the College and School departments of the Engineering College contained 181 students on the 31st March 1887, against 185 students at the close of the official year 1885-86. Seven students obtained certificates as Assistant Engineers. The strength of the College Department at the end of the year was 17—i.e., 8 in the senior, 9 in the junior division. The senior division of the Engineer Subordinates class, containing 35 pupils, "did not pass a satisfactory examination." The number of industrial schools in the Presidency rose from 10 to 16, and the attendance from 295 to 692, the majority of the pupils being Mahomedans and Native Christians. There were 82 schools for supply of special technical training to schoolmasters and mistresses. It will be in their power to do an immense amount of good work when their educational course is completed, and they permeate through the Presidency retailing the stores of useful knowledge they will have acquired in the technical schools. A scheme for the reorganization of the College of Agriculture, Saidápet, adapting the instruction imparted in that institution to the requirements of the new technical education scheme, was given effect to during the year under review. Nearly half the students in this College were Brahmans. Results in the higher examination in science, art, and industry, are said to have been very favorable. Students at the Ordnance Artificers School are also said to have made good progress. In all these institutions the physical training of pupils was had regard to, we are glad to see. At the Madras School of Art terra-cotta balustrading, flooring, tiles and stained-glass windows were executed for various churches. Experiments made with Kaolin from Katgudy proved it unsuitable for fine porcelain.

Glancing at the conduct of Municipal affairs we find that Rs. 1,71,759 were expended at the capital on the Madras Black Town drainage scheme, and that no steps were taken to proceed further with the new water supply scheme. Madras is still content to be lighted with Kerosine oil, the expense being annas 10-5 per lamp for a spell of 98 hours. Rs. 16,354 were expended during the year on the People's Park; Rs. 2,077 on the up-keep of avenues.

Notes and Comments.

SANITATION IN INDIA.—A despatch on the question of sanitation in India is expected shortly from home.

THE TRANSCASPIAN RAILWAY.—The first train over the Transcaspian line reached Bokhara on the 9th March.

THE KHOJAK TUNNEL.—The line from Killa Abdulla is rapidly being pushed on. Mr. G. P. Rose, Executive Engineer, who is shortly expected from England, will be entrusted with the making of the great three-mile tunnel assisted by several mining experts.

BHAWALPUR.—We glean that the public roads, both of main and cross-country communications, are kept in good repair; and in the matter of *serais* and rest-houses for travellers, the State is much in advance of other Native States, and will contrast favorably with many British districts.

TOO GOOD TO BE TRUE!—The *Indian Mirror* says that it is whispered that when Colonel Browne, Chief Engineer and Secretary, P. W. D., Bengal, proceeds home early next month, Mr. E. J. Martin, Superintending Engineer, Western Circle, succeeds him as Secretary and Chief Engineer.

P. W. D., MAISUR.—Mr. F. J. McLaughlin, Executive Engineer, having taken three months' privilege leave, we are glad to hear Mr. A. Govindacharlu has been appointed to officiate as Executive Engineer during the former's absence. This is the same native gentleman who officiated for the late Mr. Bayly.

THE TRANSCASPIAN RAILWAY.—Advices received in Vienna from Merv state that the Czar, accompanied by the Khan of Khiva and the Emir of Bokhara, will be present at the formal opening of the Transcaspian Railway as far as Samarcand. The ceremony is expected to take place some time during the coming summer.

BENGAL-NAGPUR RAILWAY.—The long expected "Declaration" is at last out, and we find from the latest issue of the *Calcutta Gazette* that the land required for this line between Asansol and the Damuda will now be taken up "at public expense for a public purpose," subject to the usual reservations regarding mineral rights.

NAINI TAL WIRE-ROPE-WAY.—The prospectus of this Company has reached us. The capital is 2 lakhs in shares of Rs. 100 each. The Board of Direction is good; and if the estimates are correct, the concern should work at a profit; but it is one of those companies which people on the spot can best judge of, and upon which comment is scarcely necessary.

COLOMBO AT A DISCOUNT!—The Imperial Government seem bent on concentrating their attention on Trincomalie. They are now increasing its defences, and wish to make it the military, as well as the naval head-quarters. The Admiralty do not desire, and hence their abandonment of, and refusal to contribute towards, the graving-dock scheme for Colombo.

BENGAL P. W. D. JOINT SECRETARYSHIP.—Rumor will have it, that the present Chief Engineer for Irrigation in Bengal, will be affected by the pending changes in connection with the Administrative Head of the Department. Considering that Colonel Harrison is a stranger to the Province, and junior to some of the Superintending Engineers in it, we should not at all be surprised at this.

THE HYDERABAD RESIDENCY BAZARS WATER-WORKS.—Mr. Cordery's last public function in Hyderabad, the formal opening of the Residency Bazars Water-Works,

was the unassuming consummation of an unassuming but locally very important sanitary work. It marked the inauguration of the first scientific water-supply of the vast City. Chadarghat will follow suit, and the City itself next.

ITEMS FROM BURMA.—The 59 miles extension from Toungoo towards Mandalay, it is reported, will be open for goods traffic on 1st April, and for passenger traffic on 15th May. Mr. J. F. Hewitt, a temporary Supervisor in Upper Burma, has applied for appointment as Myooke, or Subordinate Magistrate. Another temporary Supervisor, Mr. A. C. C. McLeish, has resigned because of delay in obtaining permanent appointment.

THE PAYMENT OF PENSIONS.—The *Pioneer* writes:—We should be very glad to be able to endorse the statement from Bombay, that the Secretary of State has decided on a fixed ratio for the payment of Uncovenanted Pensions in England, being one shilling and eight pence to the rupee. It may be so, but, to prevent disappointment, we are bound to say that nothing of the kind is yet known to the Government of India.

ANOTHER GRIEVANCE.—Attention is being directed to a real grievance in the Railway Branch of the Public Works Department. No promotion to this branch has been brought out since last June, and in the meantime several casualties have occurred in the higher grades, which should give permanent steps. A large number of Engineers have been sent to various Railway Companies for whom sub. *pro tem.* promotions are due.

STATE MANUFACTURES.—Government establishments in Bengal now supply public wants less advantageously, it is alleged, than they could be met from private sources. We refer to the Akra Brick Factory, Seebpore Workshops, and Burrakur Iron Works. It is in contemplation, however, to make these concerns over to Engineering firms, and should this be accomplished, the change cannot but prove beneficial to the country, and remunerative to the State.

TWO-STORIED RAILWAY CARRIAGES.—The recent visit of the General Manager of the Ceylon Railways to Europe, has evidently been utilized to some purpose. That official contemplates, we learn, introducing two-storied passenger carriages on the Colonial lines, but the tunnels seem to be an unlooked for obstacle in his way, as they will not permit of the passage of a high type of vehicles. Mr. Pearce will, however, it is supposed, not be likely to be deterred from carrying out his plans by this little difficulty!

AN ANOMALY.—Lieutenant-Colonel W. G. Cumming, R.E., is virtually Chief Engineer and Secretary to the Chief Commissioner in the P. W. D. for all Burma, and though the senior in rank and service, draws, about Rs. 200 a month less pay than Major T. Gracey, R.E., the Special Superintending Engineer and Secretary for Upper Burma. It is true that the former is only designated Secretary for Lower Burma, but even if his functions were strictly confined to the southern portion of the Province, it would not affect the issue.

RANGOON PORT TRUST IMPROVEMENTS.—The plans and estimates for the drainage of the Strand Bank between the Municipal Market and the Sulè Pagoda wharf compound have been forwarded for the orders of the Chief Commissioner with the remark that, as there is a diversity of opinion as to the best method of carrying out the work, and as to the size of the outlets, the Commissioners suggest that the matter be referred to a committee consisting

of the Chief Engineer, Public Works Department, as President, and the Municipal and Port Engineers as members.

CEYLON PUBLIC WORKS DEPARTMENT.—The following departmental changes have been sanctioned consequent on Mr. Edge being detached for service under the Colombo Municipality:—Mr. Stanley Colls, District Engineer, from Pallai to Baticaloa. Mr. Jacotine, Inspector, at present Acting District Engineer of Madawachiya, to Pallai. Mr. E. R. MacDonnell, Superintendent of Village Tanks of the Northern Division of the North-Central Province, to be Acting District Engineer of Madawachiya, in addition to his present duties. Mr. R. D. Ormsby has been granted leave for three months on full pay, and nine months on half pay.

WASTAGE OF WATER.—We have already discussed the measures taken by the Bombay Town Council to prevent waste of water. During the eighteen months that the present staff for the prevention of waste have been employed, the saving has been 2,250,000 gallons per diem. The Council has now resolved, that in cases where bungalows with gardens use more water than 25 per cent. in excess of the quantity they pay for by assessment calculated at four annas per 1,000 gullons, cost price charge should be made, in lieu of the rate leviable under sections 64 and 69, Municipal Acts, at four annas per 1,000 gallons for the whole quantity used.

WORKS OF PUBLIC UTILITY CONSTRUCTED BY PRIVATE INDIVIDUALS IN BENGAL.—Compared with the corresponding figures for the previous two years, there has been a large falling off in the contributions made for works of public utility during the year 1886, but looking to the many wants which are constantly being brought to notice from all parts of the Province, it may be expected that the decrease is only temporary. To those who have contributed towards such works during 1886, the Lieutenant-Governor tenders his acknowledgements for their public spirit and liberality. The figures for 1884, 1885, and 1886 are Rs. 5,11,885, Rs. 4,78,450, and Rs. 3,26,323, respectively.

"AN UNEXPECTED SOLUTION."—The *Pioneer* understands that the controversy about the merits of the projects for constructing a line of Railway from Kalka to Umballa by Kurnal to Delhi, which projects have been objected to in some official quarters, on account of their competing for the traffic of the North-West line between Umballa and Delhi, is likely to meet with an unexpected solution by an offer having been made to construct a line from Kalka to Umballa only, a proposal which has no opponents—by the help of certain concessions, but without a guarantee. The offer is now before the Government of India, and will shortly be forwarded to the Secretary of State.

AN INDIAN RAILWAY QUESTION.—The Right Honorable Mr. Smith received a deputation from the principal ports of England bearing a protest against the exemption from Port dues of material shipped to India for railway construction. Replying to the deputation, he promised to submit the point raised to the consideration of his colleagues, but expressed himself as being unable to admit that any real grievance existed. The Board of Trade returns shew, that the exports of railway material to India in January exceeded 50,000 tons. This is more than double the export for January of last year, and nearly as much as for all other countries put together. Our Railway Engineers should be having a busy time.

THE O. AND R. R. "TRANSFER."—The purchase by Government of the Oudh and Rohilkund Railway in accordance with the terms of the Company's contract is a decision which was some months ago made known to the public. The financial operation for which the Government now obtain the sanction of Parliament is that of substituting debt owed by themselves for the capital of the Company guaranteed by them. In respect to the other ten millions, it is, of course, merely the normal credit which the Indian Government from time to time has to obtain from Parliament before it can come into the market for its public works borrowing, and does not in the least refer to the amount of any particular impending loan.

IRRIGATION PROSPECTS IN WESTERN INDIA.—The Irrigation Revenue Report of the Bombay Presidency, excluding Sind, for the past official year, contains an important reference to the reduction of water-rates ordered in 1883-84. The reduced rates have now been in force for four years, and the result of the experiment has been most disappointing. The prediction, that decreased water-rates would induce the cultivators to apply more freely for irrigation, has been entirely falsified. By lowering the rates the department has lost considerably in revenue, the area of irrigation having shewn no increase to compensate them for the reduction. The general conclusion arrived at is that the area of irrigation will vary with the character of the rainfall, and not with the amount of water-rate charged.

SCIENCE AT A DISCOUNT.—The *Morning Post* says:—"It is one thing for the Government of India to prescribe rules regulating the size and bulk of annual reports and similar publications, and another to set the example by looking to the inordinate proportions of some of its own reports. This reflection is suggested by a more careful examination than it deserves of the twelfth report on the Meteorology of India for 1886. Mr. John Elliot, M. A., Officiating Meteorological Reporter to the Government of India, is responsible for the production of this dry, late, wasteful and unwieldy volume. A search through its pages, some 550 in number, each about a foot square, for interesting matter, has been labor in vain; and all the reader can do on closing the book in disgust is to record a protest against such an expenditure of public time and money, which its compilation must necessarily have involved."

THE KALAWEWA TANK IN CEYLON.—After months of anticipation and weeks of preparation, His Excellency the Governor has celebrated the completion of the Kalawewa tank with great pomp and ceremony. His Excellency made a rather long speech; but did not, contrary to expectation, go into the question of irrigation very fully. His Excellency very properly and gracefully gave credit to Sir William Gregory and Mr. Dickson for the inception of the work, while he spoke in warm terms of the labours of Mr. Wrightson, the Engineer-in-charge. The works call for no observation except that, without exception, the spill is the finest piece of masonry work ever done by the P. W. D. in Ceylon, both as to its design and its execution. From an Engineering point of view the work is perfectly successful, and is said to have moreover one peculiarity not possessed by any similar work in the island—it has been finished within the estimated cost.

IRRIGATION WORKS IN BENGAL.—A Calcutta paper observes, that the evidence given before the Irrigation

Commission might suggest other reasons, in relation to the Sone Canal System at any rate, why ryots will not take the canal water so long as they can possibly do without it. The subject is of considerable public interest, apart from any question of unfair treatment of a section of the community. Nearly seven crores of public money have been sunk in irrigation works in Bengal, and the net income for 1886-87 was only Rs. 2,36,762, or Rs. 19,56,284 less than the interest payable to the Imperial Government on construction loans—a debit balance which has to be met from provincial revenues. When we find the ryots, for whose benefit the irrigation system is supposed to be worked, protesting that it is made more a curse than a blessing to them, there arises good ground for inquiring whether these large sums of public money could not be expended to better advantage.

THE "ALLIED" SERVICES.—THE recommendations of the Public Service Commission are that—The Forest Department staff will be divided into an Imperial Branch recruited in England, and Provincial Branches recruited locally on principles similar to those laid down in the case of the Civil Service. The Geological Survey Department appointments are to be made as at present by the Secretary of State, without respect to the nationality of candidates. The Accounts Branch, P. W. D., will be reduced, and the establishment recruited by open competition among all classes. In the Survey Department there will be a division between an upper department to consist of military officers and specialists from England, and a junior branch to be recruited by competition among specially selected candidates in India. For the Telegraph Department recruitment in England, as at present, will be maintained, but gradual reduction will be kept in view, while a superior local telegraph service is gradually organised in India.

THE MADRAS PUBLIC WORKS WORKSHOPS.—The capital of the shops at the beginning of the year 1886-87 amounted to Rs. 2,30,684-5-7, and there was a decrease of Rs. 20,296-7-5 during the year, the capital at the close of the year being Rs. 2,10,387-14-2. The outturn of work is valued at Rs. 1,69,317-5-3 as against rupees 1,47,340-15-4 in the previous year. The increase is due to work done for "other departments" and "private parties," the work turned out for the Public Works Department having been less in the present year by Rs. 1,438-14-11. The total receipts, as shewn by the revised profit and loss account, were Rs. 21,226-8-6 and the charges Rs. 30,813-15-4, involving a net loss of Rs. 9,587-6-10. In the face of these figures, Government consider that the general results of the working of the shops are satisfactory, as, with an average outturn, the net loss is only very slightly larger than the interest on capital, or, in other words, the workshop has only just failed to pay its working expenses. *Verb sap.!*

MADRAS RAILWAY BUDGET ESTIMATES.—The cash outlay on engineering works for 1887-88 is estimated at Rs. 5,63,884, the principal items being—

	Rs.
Reconstruction of Penner bridge ...	35,620
New bridge over Chitravati ...	60,500
Extension of line to Calicut ...	2,36,384
Do. do. to Palghat town ...	58,000
Alterations and additions at Renigunta	
Junction station ...	28,000
Extension of block system ...	10,302

For 1888-89, the cash outlay on Engineering works (the total of Schedule A.) is Rs. 3,31,468, the principal items being—

Reconstruction of Penner bridge	...	Rs. 50,000
New bridge at the Chitravati river	...	1,00,000
do. at the Papaghni river	...	50,000
Extension of line to Calicut	...	57,000

AN INDIAN RAILWAY ON THE LONDON STOCK-EXCHANGE.—Tenders for £1,000,000 three and a half per cent. debentures of the Bengal-Nagpur Railway Company, Limited, were received to the amount of £3,793,600, at prices ranging from the minimum of £100 to £103 10s. Tenders at £100 10s. receive about 47 per cent. of the amount applied for, and those above that price in full. The average price was £100 11s. 5½d., but this is partly accounted for by the fact that one lady investor, who did not think it necessary to seek the advice of a broker, tendered for a considerable quantity at 2 per cent. higher than would have been sufficient to procure her a full allotment. Incidents like this are common in connection with the "tender" system of raising the capital. Those "in the know"—the broking fraternity—make a price which will leave them a profit before the stock gets into permanent hands; those who are "outsiders"—the investors—commonly bid needlessly high, and, consequently, begin with a loss on their investment.

THE INDIAN METEOROLOGICAL DEPARTMENT.—We learn from a well informed contemporary that in the Meteorological Department the first step in a series of important changes is to be taken, we understand, on the 1st April. The Department has now worked for more than twelve years on the lines laid down by Mr. Blanford in 1875; and of the two objects then aimed at—the determination of normal climatological factors for every part of India and the elucidation of the laws which regulate the distribution of rainfall—the first has been already very completely accomplished, and as much as could be expected, considering the inherent difficulties of the problems presented, has been done in the latter direction also. Whilst keeping this latter object still in view, it is now thought desirable to concentrate as much as possible the energies of the Department on the rapid transmission to the head-quarters of Government of information regarding current changes in the state of the weather, and the communication of this information to Government and to the public in a readily intelligible form.

THE PROPOSED GRAVING DOCK IN BOMBAY.—The preliminary arrangements for the construction of the new Government Graving Dock are actively in progress. Captain Hext, the Director of the Indian Marine, has availed himself of the experience of Mr. Ormiston, the Port Trust Engineer, in the preparation of estimates. The Port Trustees have also under consideration plans of the Graving Dock in connection with the new Victoria Dock for the accommodation of merchant vessels. It was at one time suggested that this Graving Dock should be constructed for the accommodation of war ships, but it was found that there would not be sufficient space for the extensive workshops which are indispensable for the repair of ironclads. Nevertheless, something has been done in the direction of making the new Graving Dock for the Mercantile Marine useful to the Navy for certain limited purposes. It has not yet been fully decided to make the new Graving Dock at the Government Dockyard, as Hog Island, where the hydraulic lift has been constructed, possesses, in many respects, superior advantages.

ROYAL MILITARY ACADEMY.—The largest number of gentlemen cadets ever brought forward at one batch were on 16th February presented with commissions in the Royal Artillery and Royal Engineers by the Duke of Cambridge at the Royal Military Academy, Woolwich. General Sir R. Biddulph, Director of Military Education, reported that, in consequence of the retirements of the service, 101 cadets had gone up for examination, 53 belonging to the first class, all of whom passed, and 48 to the second class, of whom two failed. The successful 99 gentlemen were then called forward, and presented to receive Her Majesty's commissions. 14 of the first and 12 of the second class being recommended for the Royal Engineers, and the remainder for the Royal Artillery. The reports of the examiners were generally satisfactory, and the work of Gentleman Cadet Dick, who was head of the second class, was pronounced extraordinary. The Duke, after presenting the prizes, said, that to mark his satisfaction with the conduct of the cadets, he would bring up three more candidates in the second class for the Royal Engineers.

SEVEN REASONS IN FAVOR OF A KARACHI-DELHI RAILWAY.—The following arguments in favor of this scheme are being circulated far and wide:—(1.) Because, as proved by the projectors of the Sind, Rajputana and Delhi Railway, it would pay at least 4 per cent. (2.) Because it would bring 30,000,000 of people from twenty to forty hours nearer to Europe. (3.) Because it would enable merchants to export wheat to England at a price one shilling a quarter lower than they now can by any existing railway. (4.) Because it would practically create a new port in India twenty hours nearer to Europe than any port now in existence. (5.) Because the Bombay Government and the railways inland from Bombay would not be such utter fools as to oppose it, did they not know it would give enormous advantages to British India, partly at their expense. (6.) Because it would make possible the shortening of passage and carriage of mails from Simla to England by two days. (7.) Because, politically and strategically, it would constitute a retired and practically unassailable first-class line of railway between the centre of India and the nearest port in India to England.

THE MINISTER FOR PUBLIC WORKS.—The *I. D. N.*, in discussing Sir Charles Elliott's proposed extensive tour before proceeding to Simla, says:—It is no doubt desirable that the Public Works Minister should make himself personally acquainted with large projects and works which are likely to claim his official attention. At the same time, we should consider the public money spent on these tours, and in fact the whole cost of maintaining a Public Works Minister, expended to better advantage if the officer selected for the post were possessed of special technical knowledge and training which would render his executive supervision and control and his advice to the Government more of a reality and less of a *nam-ke-waste* affair. The Public Works Minister ought to be a professional Engineer. No official who is not an Engineer—and an Engineer of exceptional abilities and experience—can possibly do justice to the appointment. We entertain great respect for Sir Charles Elliott, and think he is perhaps likely to commit as few mistakes as any non-professional man pitchforked into the same position. But the system of appointing men who are not trained and experienced Engineers to the position of head of the Public Works Department and adviser of the Government on Public Works projects is neither fair to the official himself, to the Department, nor to the public.

Current News.

Mr. J. ELLIOT, Meteorological Reporter to the Government of India, after visiting Madras and Allahabad, arrived in Calcutta last week.

THE Calcutta Municipal Bill embodies a local tax of four annas a case on petroleum, so that, with the Imperial tax, Calcutta will have to pay twelve annas a case.

It is said that Colonel Jenkins, Agent of the Ondh and Rohilkhand Railway, is about to retire, and that he will be succeeded by Mr. Hartwell, the Traffic Manager.

THE work at the new Victoria Dock has been so briskly pushed forward, that the Trustees of the Port feel able to open it on the 12th instant, instead of the 3rd of April.

It is rumored that Mr. Guildford Molesworth, C.E., the Consulting Engineer to the Government of India for State Railways, will retire from the service in May next.

A GOLD watch of the value of Rs 250 has been presented by the Punjab Government to Kaka Ram Khatri, of Ludhiana, as a token of approval for a work of public utility constructed by him in 1887.

THE work on the Artesian Well at Lucknow proceeds steadily and satisfactorily, and those who are entitled to express an opinion on the subject, anticipate successful results all in due time.

THE appointment of Sanitary Commissioner for Madras shall be an independent one, and the pay of the appointment shall rise from Rs. 1,200 to Rs. 1,800 per mensem, by annual increments of Rs. 100.

MR. HORACE BELL, the Manager of the Tirhoot Railway, is about to proceed home on furlough for seven months, and will be succeeded by Captain Kanhardt, R.E. The Tirhoot line is now, we hear, in a prosperous condition.

THE Bombay Government has decided that the College of Science at Poona is to be the central institution for the teaching of the higher agriculture, local classes and schools being established to serve as feeders to the College.

ACCORDING to a Deccan paper, the application to construct a tramway from Hyderabad to Secunderabad has been sanctioned on condition that certain streets in the cantonment are widened. If this is possible, the work will be taken in hand at once.

SIR CHARLES ELLIOTT leaves Calcutta on the 23rd instant, on an extended tour of inspection, in the course of which he will visit Allahabad, Nagpur, Hyderabad, Poona and Bombay, at which latter place he is expected on the 13th of next month.

IT was reported from England that the Secretary of State has agreed to a conventional rate being fixed for the drawing of the rupee pensions and furlough allowances in England, by European members of the Uncovenanted Service in India. The rate will probably be 1s. 8d. to the rupee.

MAJOR BOUGHEY, R.E., Manager, Eastern Bengal State Railway, returned from furlough by the last mail, and will take over charge from Major Sargeant during the week. It is probable that the latter officer will be appointed to the charge of the Sind-Punjab section of the North-Western system.

MR. S. DIGBY, late on the staff of the *Madras Times*, has been appointed Parliamentary Agent of the Uncovenanted Service Association. With Mr. King inside the House, writes a correspondent, and Mr. Digby working amongst legislators outside, some good at least will be deserved, if not indeed secured.

MR. ISMAY's recent visit to Burma is likely to bear fruit in the shape of a new steamer service on the Irrawady, to compete with the Flotilla Company. It is reported that the present fleet is quite unable to cope with the trade on the river, and that large quantities of cargo are accumulating at the various stations.

It is understood that, when Lieutenant-Colonel A. G. Filgate, R.E., Accountant-General, Public Works Department, goes on furlough in July next, prior to retirement, Lieutenant-Colonel D. H. Traill, R.E., Examiner of Public Works Accounts, Bengal, will fill the appointment temporarily, pending the return from furlough of Major G. A. Begbie, R.E.

COLONEL HOLDICH, of the Indian Survey, who did such good service in the Afghan Frontier Commission, has been forbidden by the Indian Foreign Office to read the paper on the geography of the Afghan frontier which he had promised to communicate to the Royal Geographical Society. Colonel Holdich will shortly return to India to fill an important post in the Survey Department.

By the amalgamation of the office of the Director-General of Railways with the Public Works Secretariat of the Government of India, the services of some 30 men are being dispensed with. The majority of these are temporary men in the Secretariat, but about a dozen of the Director-General's estab-

lishment are also retiring on pensions, among them being the Superintendent of the office. It is said to be the intention to locate the new office permanently in Simla from next cold season.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.

"PANDRY MUTTI."

SIR,—Please make the following corrections in my letter which appeared in your issue of the 3rd March :—

Line 2	...	...	read	<i>gonda</i>	instead of	<i>souda</i>
" 4	...	...	"	<i>Malwa</i>	"	<i>Malina</i>
" 16	...	...	"	<i>heap</i>	"	<i>lump</i>
" 22	...	...	"	<i>gum</i>	"	<i>guna</i>
						X.

TABLES FOR ROLLED IRON BEAMS.

SIR,—I have just noticed that I have inadvertently written b instead of t_2 in the formula for moment of inertia which I sent you a few days back. I hope it is not too late to correct it.

The last formula should be

$$I = \frac{t_2 d_2}{12} + 2ax^2.$$

Also, in the first and last equations substitute t_2 for b ; and in the second equation t_2 for t_1 .

QUETTA; March 4, 1888.

C. W. HODSON.

THE TRAVANCORE RAILWAY.

SIR,—Will you kindly enlighten me through the columns of your journal what action has been taken by the Government of Travancore regarding the long-talked of railway for that province; also the length of the line and through what stations would it traverse? For the above information I shall feel extremely thankful.

A CONTRACTOR.

NATIVE ENGINE DRIVERS.

SIR,—We all know that common sense is very uncommon; but if your correspondent "Common-sense"—vide your issue of the 25th February—will refer to the *Times of India* account of a railway accident on the G. I. P. R., caused by driver Power, he will have reason to modify his opinion. It occurred at the beginning of February 1887, and resulted in the total wreck of three trains in one night and loss of lakhs upon lakhs. The native fireman did the right thing in time, but Power reversed it.

OLD SUB.

KEEPING UP A ROAD.

SIR,—Referring to the letter of your correspondent "Revenge" in your issue of the 18th February, he does not say whether his gangs were placed under a headman called in different parts of the country as chupprassy, duffadar, sirdar, &c. A smart man of this description, placed over a gang of 10 to 15 men, often produces a better result than that obtained by the contract system. It is idle to suppose that a Sub-Overseer would work successfully a gang of men placed directly under him. He can certainly shew his talent in checking attendance and comparing the quantity and quality of work turned out with the amount of wages due for such work before making payment of the same; but the efficiency of the system during the interval between any two visits of the Sub-Overseer must depend on the character and qualifications of the headman. Sub-Overseers are often raw and inexperienced, if not idle and intriguing. It is therefore necessary to select practical and honest men. Even then the District Engineer cannot rest satisfied with a visit to the work once in every six months. Very often our District Boards and Local Boards are shams. I was told the other day that a member of a District Board wanted some money placed in his hands for repairing some road of his, and offered to pay some part of it to an underling if he would help him. I have myself seen another member shewing his obedience to the head clerk of a District Board evidently for the purpose that his travelling allowance bill may not be scrutinised and paid without delay. That others connected with such bodies have an interest to get some relation of his or theirs appointed as a Sub-Overseer is the rule. In such cases the District Engineer has a difficult part to play, and with heat and hard work and frequent disappointments he often has to lose temper and ultimately becomes a confirmed ill-tempered man; but the serene Magistrate and his colleagues in the District Board (mostly pleaders and officers) unused to such work, and incapable of tracing the cause of ill-temper of Engineers generally, are apt to make the irritable disposition of the Engineer a standing cause of complaint (especially if he be a native) and lose not an opportunity to bring him to grief.

Your correspondent appears to be an Engineer who has a

heart for his work; but I warn him that the time is not far distant when he will find himself a victim to his over-zeal.

There are two aspects in which the operations of our Local and Districts Boards may be contemplated. The one is represented by offices, splendid furniture, japanned tin boxes, and handsome salaries to all who may count upon the Chairman and Vice-Chairman as their *ma-baps* with nothing behind the screen but rutted roads, fallen bridges and heaps of earth thrown here and there at so much per thousand cubic feet. This phase of affairs occurs with a palefaced, broken-winded Magistrate-Chairman, given to much red tape, who expects everybody to be able to ride post-haste and break his bones with the exception of himself, touring on elephants borrowed from the zemindars, or supinely sleeping in a palki and followed by sycophants and embezzling subordinates of various departments. Another aspect is the very reverse of these things—a healthy and pushing Magistrate riding over the district with wide open eyes and punishing or rewarding men according to their true merits and bearing or believing nobody but his own ears or his own eyes. Whether this species of men do now exist is rather doubtful. The times are so changed that high salaries and no work have become the rule, and honest and hard work the exception.

OLD REGIME.

KEEPING UP A ROAD.

II.

SIR,—With reference to a letter on the above subject by "Revenge" in INDIAN ENGINEERING of the 18th instant, I venture to offer a few remarks which I trust will be found useful to those interested in the up-keep of roads.

1. About $\frac{1}{10}$ ths of the Budget Maintenance allotment of a road should be utilized in the up-keep of a permanent establishment on monthly pay, and the remaining $\frac{9}{10}$ ths on the repairs to masonry bridges and tunnels, collection of materials to miles where none is available, monsoon damages, &c., which should be done by contract or task agency.

2. The permanent establishment to be employed will generally be one man, or one man and one woman, or one man and two women, to a mile, as the above proportion of the maintenance allotment admits. These people should be called "mile coolies," and should be supplied with all the necessary road tools and a brass or thick tin badge with their numbers impressed on them, to be worn on the arms when on duty.

3. The duty of these "mile coolies" will be as follows:—

(a.) To repair holes and ruts with metal and gravel as soon as they are formed.

(b.) To keep the road surface free from stones, rubbish, &c.

(c.) To keep all the side and catch drains from being choked up, by removing at once all obstructions to the flow of water.

(d.) To keep the water-ways of masonry works free from obstructions of all kinds.

(e.) To prevent people making use of the road other than what it is intended for.

(f.) To protect the avenues when there is no separate avenue establishment.

(g.) To keep the road surface free from mud and slush in the wet weather.

4. The mile coolies should be daily supervised by "section maistries;" these men should have a thorough knowledge of the language of their districts and a fair knowledge of accounts.

5. The duties of such a maistry will be:—

(a.) To keep a daily attendance register in which the names of the mile coolies will be entered in the order of their miles.

(b.) To move about daily on his section from beginning to end, marking the mile coolies 'present' or 'absent,' as the case may be, instructing and teaching them how to conduct repairs and to see that they are doing their duties as above specified.

(c.) To write down the measurements of work done daily by the mile coolies in a book supplied for the purpose.

(d.) To submit a weekly report of his movements and work done on his section.

(e.) To write down the measurements of all materials supplied and work done on the section by contract, and to see that all work is being done according to rules.

6. These maistries and mile coolies should be nominated by the head of the Engineering Department of the district, and should be taught to look upon their work as a permanent livelihood. If this be done there will not be much difficulty in procuring good and trustworthy men, but it should be borne in mind that with an indifferent or careless *taluk* overseer or other executive subordinate they are likely to fall off in their duties.

7. Section maistries should be appointed to every 10 or 12 miles, their salaries being met from the above proportion of the Budget allotment.

February 28, 1888.

T. R. C.

THE CURRENCY QUESTION OR "EXCHANGE" PROBLEM.

SIR,—The depreciated rupee is a thorn in the breeches pockets of a good many Anglo-Indians. Bearing that in mind it is refreshing to hear that Indian industries are being industriously kicked upstairs by the departmental agencies for that purpose made and provided. Governmental reports on railways and sea-borne traffic glibly tell fairy tales of the spread of industrial works, and a steadily increasing export trade that ought by all the rules of

Cocker and John Stuart Mill to restore the rupee to its pristine value. But it does not somehow; exporters' pockets fail to show them that they are thereby advantaged as they ought to be. Still the wicked rupee is recalcitrant, a calculation-disturbing unknown quantity to the trader, an inordinate vexation to non-traders who have to remit money home for their children's education, their wives' ball dresses—what not of inevitable expenditure. Mr. Goschen, pathetically complained to the Manchester bi-metallists the other day, that the rupee had not behaved as, according to the laws of political economy, it ought to behave. Which is to blame, the politico-economic laws or the rupee? M. Cernuschi, an authority on currency questions not less authoritative than Mr. Goschen has a notion that as long as the British Government "allows" the rupee to be worth any fraction less than two shillings it levies a protective duty on goods coming from countries that maintain a gold standard. According to these two financial high priests it has put itself beyond pale of commiseration, or benefit of clergy, and ought to be summarily dealt with. The only difficulty is—how is this summariness to be brought to bear? It seems to me that initial remedies at any rate might be found? firstly in cutting down exorbitant Home Charges and consequently inordinate Secretary of State's drawings on India: and secondly in expansion of India's industries and of Indian railway systems, furthering the increase and profitableness of India's nascent export trade in food grains, cotton, wool, tea, coffee, brassware, and a lot of presently unconsidered trifles that have in them germs of capacity for the promotion of profitable trade. Let the economists look to it.

ECONOMIST.

Literary Notices.

STUDENT'S MATHEMATICAL COMPANION.—By K. P. Basu, M.A.—

Calcutta: S. K. Lahiri & Co. 1887.

THIS volume is a compilation of problems in Arithmetic, Algebra, Geometry, and Mensuration, with solutions and explanatory notes, intended for students of the Entrance and Preparatory Classes of the Indian Universities. The author is a Bengali Graduate of the Calcutta University, holding a Professorship at Ravenshaw College, Cuttack, Orissa. It has been printed in London, and is the joint publication of an English and an Indian firm.

The examples have been so selected as to be interesting illustrations of the principles upon which their solution depends, and in this lies the chief attraction of the book. They are numerous and well adapted to the object in view, *viz.*, to impart a full insight into the subject and to create a taste for a further knowledge of it by means that are as clear as they are simple.

It strikes us, however, that the book would prove more useful for students in Engineering and allied Professions than those aspiring to the ordinary Arts degrees. The contents of the book go far beyond the scope of the Entrance Examination of the University of Calcutta, and we believe that any one who will have mastered the elementary branches of Mathematics as far as covered by this volume, has laid the foundation for a good superstructure of those more advanced. The "Algebra" is, to our thinking, the best section of the book, and "Mensuration" the worst. The "Arithmetic" is good, but the "Geometry" weak. It is a long time back to our College days, but we recollect a neater and nicer proof of the theorem that "the perpendiculars from the angular points of a triangle to the opposite sides pass through the same point," in McDowell's *Exercises in Euclid and Modern Geometry*, to that given on page 297 of this volume, and Thomson gives in the Appendix to his edition of the "Elements" a simpler and easier proof of the fact that "in the figure to Euc. I. 47, the lines AL, FC, and KB pass through the same point."

Nevertheless, we think that the volume will serve an useful purpose; but it will prove more valuable to a student after his Entrance Examination than before.

New Books and Reprints.

ART AND ARCHITECTURE.

BAXTER (S.) The Morse Collection of Japanese Pottery. Illust. Folio, paper. Boston ... 5/
GOWER (Lord Ronald) Bric-a-Brac; or Some Photo Prints Illustrating Art Objects at Gower Lodge, Windsor. Roy, 8vo. Paul, Trench and Co. ... 15/; 21/
McLAUGHLIN (M. Louise) Painting in Oil: A Manual for the Use of Students, 4to, pp. 110, Clarke and Co. (Cincinnati) ... 4/

General Articles.

THE SAILORS' HOME IN RANGOON.

THIS building occupies a prominent site on the Strand in the busiest part of the town. It was erected in 1876 from the designs of Mr. H. M. Mathews, M.I.C.E.

The cost of the building and out-houses was Rs. 59,786, made up thus:—

Main building	...	Rs. 41,709
Tower	...	5,783
Out-houses	...	7,449
Enclosure wall	...	4,845

Accommodation is provided for six masters, twelve mates, and thirty seamen.

The ground floor and the tower up to the balcony are of brickwork throughout, and the upper floor and the top story of the tower of teak timber with roof of Mangalore tiles.

The cost of the building was met partly by private subscriptions and partly by a grant from the Port Fund.

DESCRIPTION OF THE BASIN OF THE INDUS AND THE FORMATION OF ITS SOIL WITH SPECIAL REFERENCE TO SIND.

To a casual and superficial observer Sind presents the appearance of a flat, barren, uninteresting desert designed only as a barrier to keep off the wild mountain tribes of the Frontier from preying upon and harassing the mild inhabitants of Hindoostan. Its excessively hot summer and scanty rainfall make life in it uncomfortable, though in a measure this is compensated for by a comparatively pleasant cold season. Nevertheless, the country is not devoid of any interest, and the perseverance and skill of man has nearly succeeded in making it a fairly populated and prosperous part of India. A few observations on the physical features of such a country and the formation of its soil may therefore not be considered without some use.

The Province of Sind, which is situated between the 23rd and 28th N. L., is about 360 miles in length, and has an average width of 170 miles west to east. The River Indus, which flows through it by a winding course from N. to S. and fertilizes its soil, derives its source from the Himalayas 1,400 miles north of Sind limits, and has played an important part in forming its soil. The country is a flat plain, except where broken on the west by limestone rocks, bordering the River Indus on the west in some parts, but at a great distance from it in others. The soil, which is rich and fertile when irrigated by canal or well water, is mostly white or grey alluvial clay mixed with very fine sand and more or less impregnated with common salt and saltpetre.

There is no doubt that the whole Province was once covered by the sea for millions of years, and that it has emerged from it only at a recent period geologically. The same remark applies to the Punjab also, as there are evidences of the sea having at one time rolled up to the foot of the Himalayas and covered the Valley of the Ganges.

As a proof of the above statement, so far as Sind is concerned, the following facts may be noted:—

1st.—The flatness of the country with alluvial soil and a slope of only about 6" per mile towards the sea on the south.

2nd.—Salt or brackish water met with in wells sunk in all parts, except in the vicinity of the existing canals or in old dhans or water-lodging places during inundations in former years. Fresh water wells turning brackish in course of time when not flushed with canal water.

3rd.—Inferior trees, shrubs and herbs of natural growth of the kind met with in salt marshy grounds found growing here with leaves which often are salt to the taste and which yield, when burnt, salts of soda and potash. The most common of all—the *jahon* tree—with salt leaves and sometimes salt sugar deposited on its boughs in the cold weather,

and the *lani* (herb) yielding, when burnt, crude carbonate of soda used by washermen, are two prominent instances in point.

4th.—Soil more or less impregnated with common salt and saltpetre met with everywhere, and when denuded of forest or left uncultivated for some years, and therefore strongly exposed to the rays of the sun, turning *kalar* or salt and unculturable.

5th.—A great depth of fine, clean sand obtained below a surface alluvium which is of an average thickness of 20 feet as observed from well excavations. How deep this sand is has not been ascertained; but it may be mentioned that ordinary well sinkings extending to 50 feet, and those for bridge foundations in the Punjab rivers going down to 80 feet, have not reached the bottom of this sand stratum.

6th.—Appearances of limestone rocks on the west originally formed in deep sea-water, but subsequently upheaved by volcanic or other agency, and still containing in some places hot water springs, clearly prove that the country must have remained under sea-water for hundreds of thousands of years.

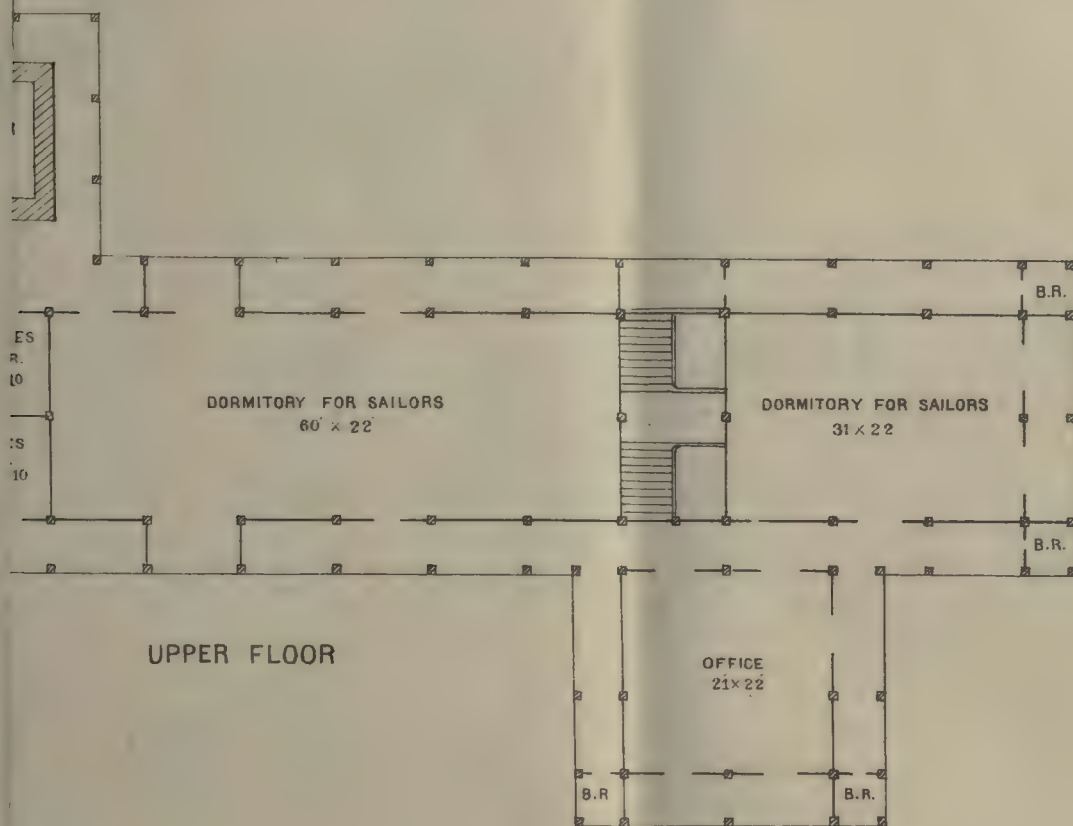
These rocks are mostly from 50 to 700 feet high in Sind, with layers sometimes nearly horizontal, and from a few inches to one foot in thickness; but not fissile or laminated. At others they are greatly inclined, and as at Laki, where there is a hot water spring existing, and which is apparently the site of an extinct volcano, nearly perpendicular. In places, as at Sehwan, they are found in boulders embedded in sand, and from the appearance of the highly inclined rock above, with sand at the foot, it seems probable that these rocks underlay a great depth of sand, and during volcanic eruptions the sand was thrown down along with the masses of rock at top and has to this day remained mixed with them, giving to some extent the relative positions of sand and limestone in Sind.

The great depth of sand overlying the limestone formation is remarkable. It is impossible, without actual borings, to state, with any pretence to accuracy, what the probable depth of this sand is, and whether any layers of silt or soft rocks intervene it and the limestone below.

The common idea is, that it was formed at the bed of the River Indus, which is said to be constantly changing its course. This theory would, however, require that the river should have rolled throughout the entire width of Sind and beyond, and even then it would not satisfactorily account for its great depth and the salt water met with in it in most places. It would thus appear that the sand is in all probability the sand left on the sea shore when the sea gradually receded from the Himalayas probably in the time of some great deluge.

The soil of Sind was no doubt at first formed at the estuary of the river, in the same way as land is now being formed at the present mouths of the river; subsequent annual floods and overflowing of the banks owing to its shallow bed, winding course, small fall of 4" to 6" per mile and a large quantity of flood-water to discharge, have also contributed greatly to the present thickness of the alluvial soil. It, however, appears that the rising of the limestone rocks by volcanic or other agency thousands of years ago has more or less fixed the present course of the river, from which it does not seem that it has departed to any great extent, and the overflowing of its banks has also been since considerably checked.

The soil of Sind belongs to the Miocene age of the Tertiary system. The formation of limestone rocks which underly the great depth of sand is placed by geologists in the Eocene age, in the belief that it is nummulitic limestone formed of coin-shaped foraminiferal shells. The rocks are, however, mostly close-grained and compact, and contain large sized fossils of a higher order, while the shells are indistinct. Again, their appearance in the lower Narri Valley, on the Pishin Railway, about 3,000 feet above sea-level, where they are observed overlying, and some-



WEST ELEVATION.

(Sd.) H. M. MATHEWS, C. E.,
EX ENGINEER RANGOON,
Town Divn.

times interstratified with apparently decayed and soft shaly strata of greenish color (probably belonging to the Silurian or other older system), points to their early origin. It is, therefore, not unlikely that with the facilities now afforded by the extension of the Railway to Sind and Pishin, a further minute and thorough examination of these rocks by experts, and the investigation of their fossils, will result in our attributing them to a more remote period than that of the Eocene age. This view is further strengthened by the schistose rocks found in the Upper Bolan and Pishin Valleys and at Quetta, and the prospect of finding coal in the Bolan Valley where the appearance of a seam has already been reported.

It may be stated that the rocks in these two valleys present distinct stratification, very interesting to a student of geology. The strata are much disturbed by upheavals and are inclined to the horizon often at an angle of 40° to 50° in the lower, and 60° to 90° in the upper portions of these valleys and at Quetta. There is no sandstone found here, nor the kind of sand full of glistening mica which is met with in Sind.

Before concluding this notice it is necessary to state that the present prosperity of Sind is in a great measure due to its alluvial soil, and to the facility with which water can be supplied to most parts of it, for agricultural purposes, by means of canals and *oorlas* (Persian wheels with small lifts) in the inundation season. The climate, although severe, is not unhealthy and not much rain is really wanted for the requirements of the country, as it would be likely to produce sickness. The average rainfall of the Province is not more than 4 or 5 inches, but the severity of the climate in the hot season, viz., from May to September, is tempered by the winds from the east and south, as there is always sufficient fall of rain from June to September in the Provinces lying in these directions.

The conservancy of the river by protection *bunds* in recent years has, beyond doubt, saved the Province from the danger of disastrous floods and devastation and improved its sanitation. It is however a point of dispute as to whether these good results have been attained without some sacrifices. The adherents of the old

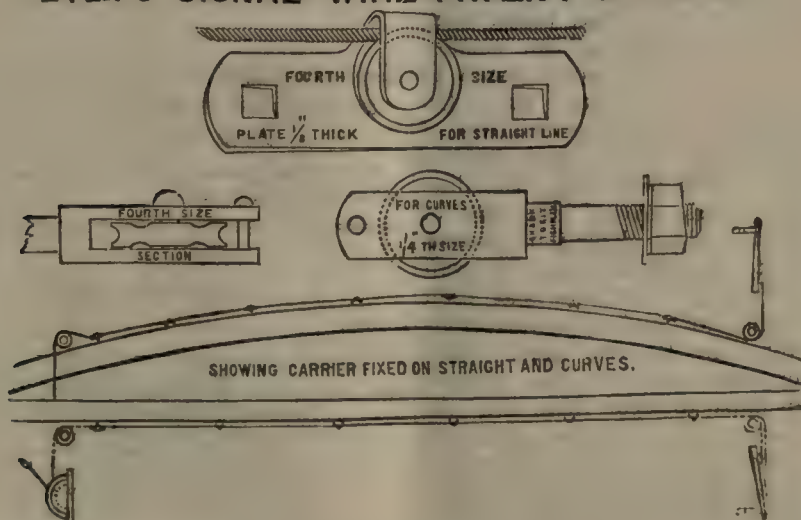
state of things say that the soil, which by the spreading of flood-water over extensive areas in former years used to be enriched annually by fresh coatings of silt and provided plenty of pasturage to cattle and sheep, and encouraged the growth of natural forests, has not only lost these advantages now, but has become liable to turn salt or *kalar* as it is called, and the fear is that unless vegetation is preserved and encouraged, and irrigation largely extended, a large part of the country may, in course of time, become an unculturable salt waste, if the floods are kept out. This gloomy view is however not accepted by the advocates of the present system. There are, of course, strong grounds for arguments on both sides.

Sind clay, as containing a very large proportion of fine sand and no *kunkur* pebbles, is eminently suited for brick-making, pottery and terra-cotta work; and it is here that large sized bricks 18" x 18" x 3" to 4" thick for flooring or other special purposes are easily and successfully prepared. The herb *lani* as previously stated, yields plenty of carbonate of soda, and as limestone is at hand, and suitable sand available, especially at Sehwan, the Province affords remarkable facilities for the manufacture of soap and glass-work which no other part of India, except the Punjab, and probably one place in Guzerat, viz., Kupudwunj, where glass is made from surface sand called *oore*, can boast of. Glazing tiles and pottery have been here practised from a very early period, as is evident from the *kassi* work which is found beautifying the floors and faces of mosques 600 years old. The art is however now rapidly dying out, and is in danger of being lost altogether, as the few men who are acquainted with it, are very jealous of their monopoly and will not reveal the secrets of the manufacture to outsiders.

Fuller's earth (called *met*) is found in Sind and gypsum used in plastic art. There is also plenty of *pán* grass suited for the manufacture of fine China mats, growing in the Mancher and other large lakes and marshy lands on the south. The encouragement or improvement of these several industries would largely conduce to the prosperity of the Province.

G. R. T.

LYLE'S SIGNAL WIRE PATENT CARRIER.



LYLE'S PATENT CARRIER.

We have been asked to give our opinion on this little contrivance, a description of which has been forwarded us by the inventor. Though we have not seen any at work, we may (judging from the sketches) assert that Mr. Lyle has hit on a very good idea.

These guides or carriers do away with the antiquated plan now in use, of carrying the signal lines on small pulleys attached on to stakes driven into the ground; the disadvantage of the latter must be apparent to many Permanent Way Officers. Mr. Lyle has patented two descriptions of his Carriers, one for curved rails, and

the other for straight rails. The patent consists in fixing these carriers on to the fish plates at the joints of the rails and the mode of riveting the small pulleys on to the brackets, which gives perfect security. They make steady guides for the wire which regulates the action of the arms of the semaphore signal.

We have no doubt that the "Patent Carrier" will meet with success, and the fact that the cost is less than a half of that of the devices heretofore employed for like purposes must materially conduce to its general adoption. It has been already introduced on the Nizam's G. S. Railway.

A BLASTED WALL.

BY JOHN HARRIS, M.E.

THE new dock at Bombay, now completed by Messrs. Kirby and Co., Contractors, is connected with the Prince's Dock by a communication passage 64 feet wide, the walls of which are joined into wing walls left in anticipation when the Prince's Dock was constructed some nine or ten years ago. To complete the communication between the two docks it was necessary to remove a wall from across the entrance of the passage. This wall formed part of Prince's Dock wall; it was about 80 feet long, 36 feet high by 17 feet thick at the base, reduced by offsets to 5 feet 4 inches thick at the line of coping. Operations were commenced on the wall in December last, by cutting it away at the back and reducing it in thickness to 9 feet at the base; it was left its original thickness at the top. As the wall was reduced it was supported by strutting with teak-wood logs, of which there were two rows; the top row consisting of 4 logs, each 36 feet long by 1 foot 6 inches diameter, the bottom row of 4 logs, each 22 feet long by 1 foot 6 inches diameter.

Four rows of boreholes (nine in a row), each $2\frac{1}{2}$ inches diameter and from 5 feet 9 inches to 6 feet 6 inches long, were bored into the wall from the back at an angle of about 45 degrees to the horizon, spaced 8 feet apart in the horizontal line and 6 feet apart in the vertical. These were to receive the charges of explosives for blasting the wall. The height of the wall was then reduced by taking off 8 feet from the top, which brought it down to nearly dock low-water level and allowed the water to flow over and fill the space between the wall and the caisson which barred the way at the new dock end of the passage, while preventing the water from getting access to that dock. All being ready, blasting operations were commenced on 11th January 1888, by a diver loading the top row of 8 boreholes, each with 6lbs. 5oz. of dynamite and an electric iridium platinum wire fuse. These were coupled up in single circuit and fired simultaneously with the immediate result of a great commotion in the water. The top row of logs forming part of the strutting came floating up to the surface with considerable violence; several large fishes and a crowd of small ones which happened at that time to be prospecting in the immediate vicinity, met with their quietus and came floating to the surface. There was a regular scramble by the native boatmen for the big fishes, which were all secured, as well as a large number of the smaller fry, but the remnant of the little ones soon began to show signs of vitality and quickly cleared out. On examination by the diver it was found that the top of the wall was standing practically intact from end to end, and that it had been blown out along the line of shotholes all the way across, leaving the top of the wall standing as a perfect bridge. This the operator afterwards learnt was owing to the omission when the wall was reduced to take out three large bond stones at each end of the wall. These stones weighed about three tons each, and were bonded into the Prince's Dock walls, making such a powerful bond that the shots (the nearest of which was 14 feet off) failed to break them out. As they were above the low-water level of the dock, the water was reduced to that level and they were afterwards removed by hand labor to prevent shaking the side walls in blasting them out. Meantime 8 holes, each about 1 foot deep by 4 inches diameter, were jumped into the top of the wall—being spaced about 8 feet apart. These were on the following day charged with an 8lbs. cannister of dynamite apiece, and fired simultaneously by electricity, completely breaking down the top of the wall. On the 13th idem, the second row consisting of 9 boreholes were loaded with much heavier charges, amounting in all to 46lbs. of dynamite and 54lbs. of blasting gelatine, and fired simultaneously, causing a violent commotion in the water, releasing the remainder of the teak wood logs of the strutting, which came bounding up to the surface with considerable speed. The wave of water by this round of shots

lifted for a moment the caisson an inch or two, allowing a little water to escape under it into the new dock, but it immediately settled into position again. On examination by the diver it was found that the section of wall commanded by this round of shots had been swept out from end to end. After this the divers were employed several days, as well as a dredging machine, clearing away the *débris* before any more boreholes could be got at. As the boreholes became accessible they were from time to time loaded and fired with nothing further particular to note except that the fishes had taken notice and kept away. The last three boreholes of the bottom row were fired on the 4th February 1888, leaving the wall a chaotic mass of ruins to be removed by divers and a dredging machine.

The wall was a splendid piece of masonry. The cement mortar appeared to be as strong as the stones; it was perfectly watertight, for when the blastholes were bored into it, and nearly through, not a drop of water leaked into them; nevertheless, the action of the vibration from the heavy charges of dynamite and blasting gelatine was so violent as to shake the stones clear from the mortar, leaving them as clean as when new from the quarry.

The wall was thinned down, strutting fixed, blastholes bored, and other preparations made under the able supervision of Mr. Wately, one of Messrs. Kirby and Co.'s assistants. Able and willing helps was rendered to the operator in the blasting work by Mr. Blackmore (also an assistant of Messrs. Kirby and Co.), who prepared and fired a number of the charges himself, and under whose supervision the clearing away of the broken wall was conducted, as well as the firing of such further face charges as were needed for levelling off bunches of wall standing up in the bottom of the passage not reached by the last row of shotholes.

The explosives and blasting apparatus were supplied by Messrs. Ewart, Latham and Co., Bombay, Agents for Nobel's Explosives Co., Glasgow. The electric exploders used were a Siemen's small magneto Quantity Exploder, size $8\frac{3}{4}'' \times 5\frac{1}{2}'' \times 5''$, and an American magneto machine, both of them portable, handy, useful machines, of about equal power. They were used alternately and acted most satisfactorily.

The accompanying plan and table of quantities with description of charges will further explain the operations.

CALCUTTA; February 19, 1888.

J. H.

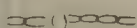
Explosives used in blasting away the wall across entrance of communication channel between Prince's Dock and New Dock at Bombay.

N.B.—The numbering of the boreholes in each row is from right to left as shewn on plan.

1888.	Description of Charges.	Number of shots.	Computed Weight.		
			Dynamite.	Blasting Gelatine	
			lbs, oz.	lbs.	oz.
Jan. 11	8 boreholes, top row, No. 2 to 9 inclusive; charge in each a cannister $2'-1\frac{1}{4}'' \times 2\frac{1}{2}''$ and a cannister $1 \times 2''$ (= 6lbs. 5 oz.) dynamite; fired simultaneously—broke hole through whole length of wall and left the top standing like a bridge.	8	50	8	0 0
" 12	8 vertical holes on top of wall which failed to come away yesterday; charge in each a cannister $1' \times 4''$ (= 8lbs.) dynamite; fired simultaneously. ...	8	64	0	0 0
" 13	3 bore holes, No. 19 first row; charged with a cannister $3' \times 2''$ R. Gelatine (6 lbs.) and a cannister $2'-1\frac{1}{4}'' \times 2\frac{1}{2}''$ (4lbs. 5 oz.) dynamite; two holes one on top of each end of wall, each charged with a cannister $1' \times 4''$ (= 8lbs.) dynamite; fired simultaneously ...	3	20	5	6 0

28'6"

2)

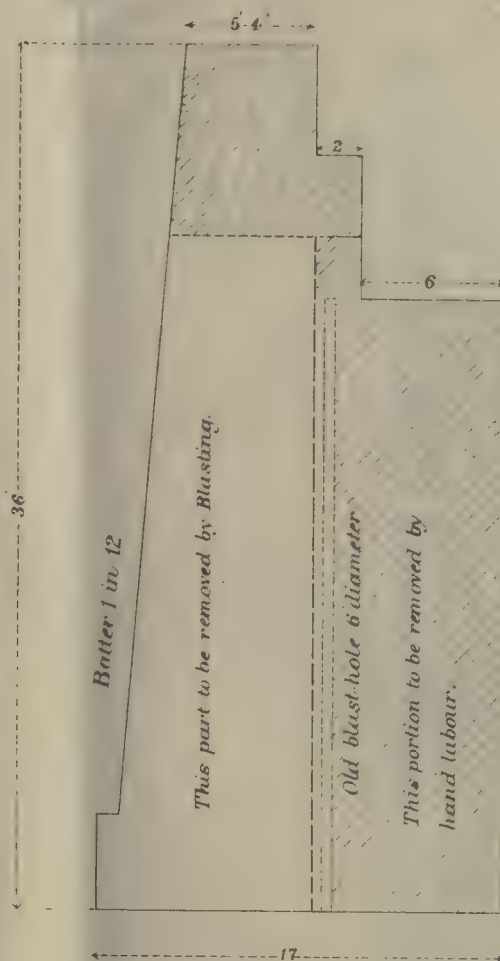


Charge for
each Blasthole.

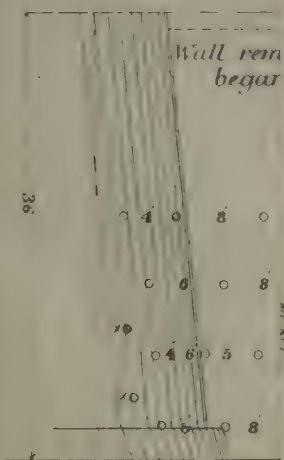
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Scale of Sections $\frac{1}{8}$ - 1.

taken off
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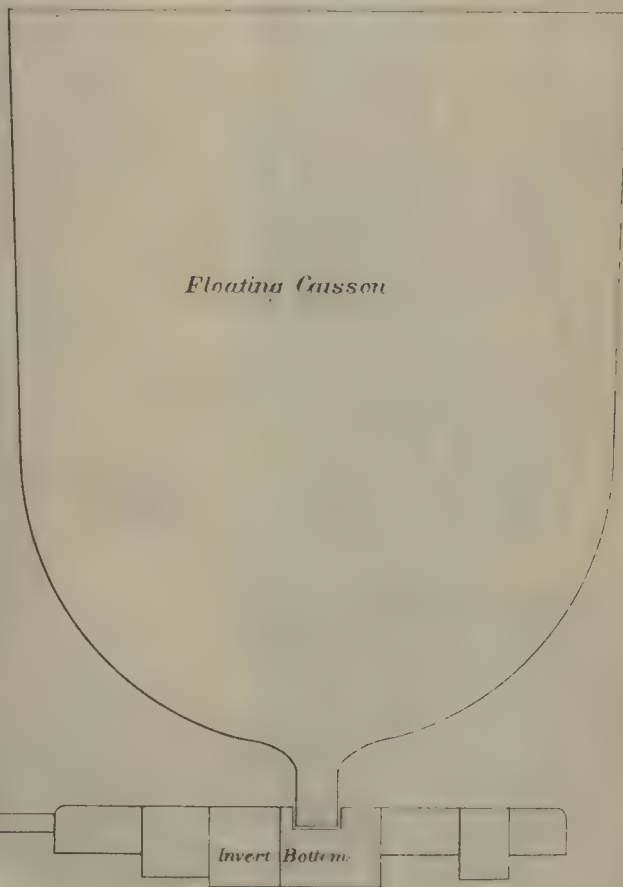
Section of wall
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Wall rem
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Extra Bl

Elevation
Princes 1
of Blasth



Floating Caisson

Invert Bottom

JOHN HARRIS.

1888.	Description of Charges.	Number of shots.	Computed Weights.			
			Dynamite		Blasting Gelatine	
			lbs.	oz.	lbs.	oz.
Jan. 18	9 boreholes, comprising the whole of the second row, each charged with a 3' x 2' canister of B. Gelatine (6 lbs.) and a 2'-1½" x 2½" canister of dynamite (4lbs. 5 oz.) No. 4, 5, 6, and 7 boreholes an extra charge of 1' x 2" canister of dynamite (2lbs.); fired simultaneously ...	9	46	13	54	0
" 20	On examination by the diver it was found that No. 3 hole, second row, had not exploded; a small charge was placed in contact and exploded ...	1	...	8	0	0
" 21	2 boreholes, 4th and 5th, third row, each charged with a 3' x 2" canister B. Gelatine (6 lbs.) and a 2'-1½" x 2½" canister dynamite (4lbs. 4oz.) failed to go off; were taken out and defective fuse removed, and new ones put in; fired simultaneously.	2	8	8	12	0
" 24	2 boreholes, No. 6 and 8, third row, charge in each a 3' x 2" canister of B. Gelatine (6lbs.) and a 2'-1½" x 2½" canister of dynamite (4lbs. 4oz.), fired simultaneously.	2	8	8	12	0
" 25	1 borehole, No. 9, third row, 3' x 2" canister B. Gelatine and 2'-1½" x 2½" canister dynamite. 1 shot in broken face of wall, canister 1' x 4" ...	1	4	4	6	0
" 27	1 borehole, No. 2, third row, canister 3' x 2" B. Gelatine and 2'-1½" x 2½" canister of dynamite. 1 borehole No. 1, third row, do. do. ...	1	4	4	6	0
" 31	1 borehole, Extra hole, between 2nd and 3rd row, 6 canisters, each 6" x 2" (1lb.) and one canister 2'-1½" x 2½" ...	1	10	4	0	0
" 31	1 shot in broken face of wall, canister 1½' x 4" ...	1	8	0	0	0
" 31	1 borehole, No. 7, third row, 3' x 2" canister B. Gelatine, 2'-1½" x 2½" canister dynamite, 1 shot in broken face of wall 1' x 4" canister ...	1	4	4	6	0
" 31	1 shot in broken face of wall 1' x 4" canister ...	1	8	0	0	0
" 31	1 shot in broken face of wall 1' x 4" canister ...	1	8	0	0	0
" 31	1 shot in broken face of wall 1' x 4" canister ...	1	8	0	0	0
" 31	2 boreholes, No. 4 and 5, fourth row, in each a 3' x 2" canister B. Gelatine-2'-1½" x 2½" canister dynamite (4½lbs); fired simultaneously, ...	2	9	0	12	0
" 31	1 borehole, No. 6, fourth row, canister 2'-1½" x 2½" (4lbs. 8oz.) and one 6" x 2" (1lb.) dynamite and 3' x 2" canister B. Gelatine. 1 shot in broken face of wall 1' x 4" canister ...	1	5	8	0	0
" 31	1 shot in broken face of wall 1' x 4" canister ...	1	7	0	0	0
" 31	1 borehole, No. 1, fourth row, 3' x 2" canister and 1' x 2" canister B. Gelatine (=in both 8lbs.) and 2'-1½" x 2½" canister of dynamite ...	1	4	4	8	0
" 31	2 boreholes, No. 7 and 8, fourth row, in each 3' x 2" and 1' x 2" canisters B. Gelatine (8lbs) and 2'-1½" x 2½" canister dynamite (4lb. 4oz.), fired simultaneously, ...	2	8	8	16	0
" 31	1 borehole, No. 9, fourth row, partly obstructed by debris, 1' x 2" canister B. Gelatine, and 2'-1½" x 2½" canister dynamite, ...	1	4	4	2	0
" 31	1 shot in broken face of wall 1' x 4" canister ...	1	8	0	0	0
" 31	TOTAL ...	52	312	14	152	0
" 31	Quantity of No. 1 Dynamite actually used ...	...	326	4	0	0
" 31	Quantity of Blasting Gelatine actually used ...	...	...	...	150	8

The fuses used were iridium platinum wire electric detonator fuses. The exploding electro machines used were a Smith's No. 3 magneto exploder (American), and a Siemens small new pattern magneto Quantity Exploder, size 6½" x 5½" x 5", competent to fire about 15 fuses simultaneously through 300 yards of No 8 iron telegraph wire; weight of machine about 11lbs.; both machines are about equal power.

JOHN HARRIS,
Mining Engineer and Dynamite Instructor,
BOMBAY; February 4 1888. Nobel's Explosives Co., Limited, Glasgow.

THE HAULAGE EXHIBITS AT THE NEWCASTLE EXHIBITION.

II.

12. MANY attempts have been made to apply small fireless locomotives to the work of haulage in mines. The Earl of Durham exhibits Lishman and Young's patent Air Locomotive, which has been successfully employed for many years at several of His Lordship's collieries. The locomotive has four wheels running on a gauge of 33½ inches; and two cylinders each 4 inches diameter and 7 inches stroke, and is worked by air at a pressure of 400 pounds per square inch, and stored on a tank placed above the engines. The air compressor consists of a pair of vertical engines, each 12 inches diameter and two air cylinders each 8 inches diameter. The air is compressed in two stages, first to 80 pounds, being drawn from the atmosphere upon the top of the piston, and compressed through water spaces into the trunk on the underside of the piston, where the pressure is raised to 400 pounds; it is then passed through a copper coil immersed in the water tank (which surrounds the air cylinders) to a receiver, from which the locomotive receives its supply. The air passes through a trap, where all the water is separated, before being delivered into the receiver. The locomotive, which is a beautifully finished piece of work, and the air compressor for supplying the motor power are manufactured by the Grange Iron Company, who are the sole makers of this class of engine.

13. Towards the close of the exhibition, Messrs. Immisch exhibited one of their 15 horse-power electro-motors which is applied to working a short endless rope system. The motor is reversible by the employment of two sets of brushes upon a rocking frame. The motor is started with a number of iron wire resistance coils in circuit, which are switched out as the speed increases. The line is about 100 yards long and 24-inch gauge. A 1½ inch wire rope is employed carried round 5 feet pulleys at each end of the line. One of the pulleys is used as a driver, and has a worm wheel keyed upon the same shaft, which is driven by means of a single-threaded screw connected with the shaft of the motor by means of a flexible coupling. The various details of the arrangements were carried out under the direction of the late Mr. Mathew Heckels. The motor is designed to run at 1,200 revolutions per minute, the electrical quantities being 300 volts and 50 amperes, or 20 electrical horse-power; it is driven by the current from a Victoria dynamo situated about 1,000 feet from the motor. From experiments which have been published, it appears that about 10 electrical horse-power were required to move 7 tubs carrying a load of 5½ tons at a speed of about 3 miles per hour. As usual in such experiments, the indicated horse-power of the engine driving the dynamo are not published!

14. Messrs. T. B. Jordan, Son and Commans shew Otto's patent wire rope way for transporting minerals, loading and unloading grain, removal of debris, &c., &c. Strong wire ropes (carrying ropes) are strained between the points to be connected, by means of weights in such a way as to expand or contract with changes of temperature. Intermediate supports are placed where necessary, and are sometimes 1,500 feet apart. There is a special light endless wire rope (under the carrying ropes) for the haulage of the trucks or skips. This rope is carried upon horizontal grooved pulleys at the terminal stations, one of which is driven by a small engine.

The steam for driving the whole of the engines connected with the Haulage Exhibits is supplied from one of Robey and Company's well-known form of locomotive boilers of 30 horse-power.

The whole of the wire ropes, upwards of 4,000 yards in length, were supplied by the Hartlepool Ropery Company, Limited; these ropes are made of extra improved plough steel wire under "Lang's" patent. Each rope is made of six strands each of seven wires of tensile strength of

110 tons per square inch. The excellence of these ropes is evidenced by the manner in which the rope employed to drive all the systems from 2 to 8 inclusive bears the most severe treatment to which a rope could be subjected. Briefly an endless rope less than 100 yards is passed round and drives or is driven by five pulleys; and is successively subjected to the most severe strain and flexures: after six months' use for eight hours per day, it does not shew a single broken wire.

The whole of the systems are laid with steel rails supplied on loan by Mr. Sisterson of Newcastle-upon-Tyne, weighing about 24 pounds per yard.

No. 10 system was laid with steel sleepers, with the Colquhoun patent fastening made by the Tredegar Iron Company. In this fastening two holes are punched in the sleeper, on each side of the bottom flange of the rail. A steel C-shaped clasp is passed through these holes, which grips the bottom flange of the rail, and the whole is firmly bound together by a metal key driven between clasp and the flange of the rail. Each sleeper weighed 14 pounds. No. 9 system was laid with steel sleepers of the Indian Railways pattern made by the Moss Bay Hematite Iron & Steel Company, Limited. These Haulage Exhibits were full of interest to Mining Engineers, who came from all "arts and parts," and are of the most careful inspection. One of the most interesting views of the working of the several systems is seen from the bridge erected at the north-end of the grounds: it is a most busy scene of moving tubs and workmen, almost equal to the Strand upon a busy day.

The visitor will realize the marvellous improvements which have been made in underground haulage, since the time (less than 100 years) when the workings seldom extended to more than 200 yards from the shaft, and the coal was conveyed in sledges drawn by horses and ponies along the floor of the seam. The use of tubs with flanged wheels running on edge rails dates from 1834-35. The use of horses and ponies for haulage has been, to a great extent, superseded by attaching the tubs to iron or steel wire ropes or chains actuated by fixed engines, worked by steam, compressed air or electricity generated upon the surface.

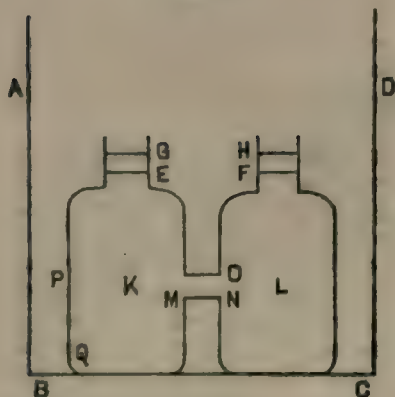
M. W. B.

PROPERTIES OF FLUIDS.

By A. EWBank.

V.

Fig. 6.



In the last paper we have seen how a small—or large—quantity of fluid introduced into a vessel L *fig. 6* causes movements and re-arrangements throughout other vessels which have fluid communications with L. When these re-arrangements have been completed—and the time they require for completion depends on the length and narrowness of the connecting channels such as the tube O—there is no sign left as to whether the additional fluid had been introduced into L or introduced into some other, or some others, of the vessels in communication. This re-adjustment of the whole body of liquid in response to an

increment of volume in one part—this sympathy or sensibility—we have expressed by the word *solidarity*.

The word *solidarity* was originally French (*solidarité*). It was introduced not as a term in physical science, but in social or political economy. For example, an employer of labour such as the owner of a large factory—may engage his workmen at the lowest rates the market price will allow. He may give them work as continued and exhausting as the helplessness of the workmen permits. He may pay them so long as they are in good health and stop all payments for absence, even though the absence is due to severe sickness. He may consider it beyond his province to interest himself in their social or family welfare. Such a man would be described as deficient in the sense of human solidarity.

On the other hand, if the employer looked upon his men as something besides mere machinery to give him a percentage on his capital—if he studied the well-being of his employes, not only in the factory but in their family and citizen life—if he was ready on occasion to place the moral welfare of his workmen—or their mere physical health—above the chance of increasing the profits of his own business—such a man would be said to recognise the solidarity of men and of their interests as citizens of a country.

Many terms now used in science with meanings carefully defined, *i.e.*, carefully limited, were originally words of common speech and had then that vagueness of definition—that cloudiness of outline—that ordinary words possess. The analogy between the units we call men, and the units we call molecules of water is perhaps now visible. Solidarity is a mutual dependence—an inter-dependence—a ready propagation of change or influence throughout a mass either of what we call living men, or what we call lifeless particles.

We thus apparently arrive at the curious result that fluids are more strongly gifted with the attribute of solidarity than are the bodies which we call solids. For in *fig. 6* let us suppose that when the water in the vessels K and L had reached the level E F this water became frozen. Then on the ice at E we could pour water up to G, and it would not be necessary to add any weight on to F. There would be certain accessions of pressure reaching through various parts of the ice in K. But the increment of pressure added at E would not be transmitted undiminished up to F as was the case with a liquid substance. Moreover, after the fluid in K was frozen we could diminish the thickness or strength of the material of the K vessel, and the vessel would not burst either without or with the added pressure at E. Thus the state of strain introduced near E is imperfectly transmitted through the whole material E M N F of frozen fluid. This imperfect transmission means imperfect solidarity—as the term has been now defined.

But the fact is that we have arbitrarily assumed that a mass of ice is a solid, while an equal mass of water occupying about the same volume—occupying indeed as we may on examination discover a volume smaller than does the ice—is not a solid. But the truth is that water is also solid. Even popular expressions sometimes recognise this property of water. Thus we read of a solid wall of water advancing up a river when the phenomenon called a "bore" is described. Again a number of men all voting for one and the same candidate are said to give a solid vote. In these two latter cases a reference seems suggested to strength in movement or momentum.

If we divide bodies into rigid bodies and fluid bodies—a fair though rough classification—we shall in the first category place such a body as cold iron. In the second category we shall have warm water and also the air we breathe. We might, however, with as much propriety divide bodies into solids and gases. Then in the first list we put both cold iron and tepid water, while in the second list we have hot steam as it exists in the boiler of a locomotive where it is as invisible as is the atmosphere.

To water in its ordinary liquid condition we cannot deny the attribute of solidity. Rigid it is not, solid it certainly

is. A solid body is that which occupies a certain volume of space and which resists an immediate displacement from that space volume. It must moreover—to satisfy the popular—and in this case also the scientific—conception of solidity have some appreciable weight for a moderate volume and some recognisable form. This form must have a clearly defined bounding surface. All these attributes water possesses.

If we endeavour gently to move a portion of water, the water yields to our pressure. If we aim at making the motion instantaneous the water becomes adamant. An iron cannon ball striking the surface of a lake with great velocity and at a small angle to the surface is flung off as decidedly as if the ball were only cork and the lake one mass of steel.

The twofold division of all bodies in nature into solids and gasses is not satisfactory, neither is the division into rigid and fluid bodies. A more complete classification would give us rigid bodies, liquid bodies, and gaseous bodies.

But even this is not perfect. A stick of sealing wax when cold is decidedly rigid and indeed is brittle—a quality which no fluid could possess. If we melt the wax it becomes a decided liquid. It changes gradually from the brittle state to the liquid state. At what stage in its progress shall we deny to it the name of rigid and accord it that of a liquid?

Difficulties of this type attend all classifications of living or inanimate objects. A full blue colour is quite different from a full green colour. But between these two we have a number of greenish blues and blueish greens that make as it were an uninterrupted passage between the extremes of full green and full blue. Similarly yellow can pass into red through tints that we call orange.

An animal is generally considered to be quite distinct from a vegetable. One we think of as roving over the earth and hunting after its food. The other we think of as rooted to one place.

But if we find a plant though rooted catching insects and digesting them—just as does a spider who spreads his web—shall we continue to call that plant a plant or must we say it is like an animal?

Iron and some other metals are hard enough to be made into cutting tools and they sink if placed in water.

But if we found a substance soft enough to be cut by a wooden knife, and if this substance when placed in water floated—and perhaps passed through certain changes—should we call this body a metal? Yet there is such a body which on good grounds is entitled to be called a metal and the name of this body is sodium.

The fact is that nature is not classification, but rather the baffling—the bewildering of classifications. Classifications do not exist in nature, they are merely steps prepared by us for our helplessness to lead us on to knowledge.

The surveyor desires to survey India—to learn its shape and area. He divides the land near him into triangles. Round these he forms other triangles and so he travels onward, converting the plains and mountains into networks of triangles. But these triangles have no intrinsic relations to the scenery, they are figments of his own devising. Now what the triangles of the surveyor are to the fields and the hills, such are classifications made by man to the varied richness of nature.

NEW FLOATING DOCK AT SYDNEY.—The first half of an iron floating dock was launched on the 30th November 1887, at the Atlas Engineering Company's Works, Woolwich, Sydney, New South Wales. This half dock can be used by itself pending the completion of the second half, and is capable of lifting a vessel of 1000 tons. When the two halves are connected, the dock will lift a 2500 ton vessel in less than an hour. An advantage of the dock will be that it can be readily converted into two docks, should two vessels of moderate size require repairing at the same time. The construction of the dock, which will be finally completed in March 1888, has been under the superintendence of Mr. J. R. Thomson. The launch of the first half was most successful, despite the awkward form of the structure.

NOTES FROM HOME.

(From our own Correspondent.)

THE reports of the Railway Companies for the past-half year, and the speeches of the chairmen of the companies at the meetings already held refer in encouraging terms to the general improvement in the trade of the country. Evidence of this revival in business is seen in the aggregate result reported by the sixteen leading English companies. On those lines there was for the past six months an increase in the gross receipts of £525,000. In the corresponding period of 1886 there was an increase of about £220,000, so that the returns for the past six months are £745,000 above the 1875 figures. To earn the additional revenue the companies had to spend £319,000 more, leaving a gain of £206,000 in the net receipts.

Experiments have recently been made in a special building in Southwark to test the efficiency of silicate cotton as a preservative against fire. In the case recorded the result was compared with two rolled iron joists placed six inches apart, braced together and embedded in solid concrete, and to prevent the concrete from cracking pieces of $\frac{1}{4}$ inch iron rod were twisted round the girder at every 10 inches, a security seldom found in ordinary buildings. The other girders were treated with a layer of silicate cotton about an inch in thickness held together by a small wire netting and faced by a cement of plaster and silicate. The concrete protected girders gave in after 7 hours and 51 minutes' exposure to a fire varying from 1,500 to 1,700 Fah., and one minute after the silicate cotton protected girders followed. In each case the girders were loaded with iron pigs weighing thirty hundred-weight.

At a meeting of the North of England Institute of Mining and Mechanical Engineers a report was read from the Committee appointed to inquire into the observations on earth tremors with a view to determine their connection, if any, with the issue of gases in mines. Seven months' results of experiments with a Seismograph at Marsden were given, and movements here recorded appear to be connected with disturbances far distant from the observatory. These experiments are to be extended with a more perfect form of instrument, and the continued observations will be accompanied by the measurements of the percentage of gas found in the return air of the mine, which will be made by some of the best apparatus for such purposes. The measurements of the proportion of gas have not been made up to the present time, but it may be mentioned as a curious coincidence that the disturbances of 6th and 8th December were closely followed by increased issues of gas at several of the collieries of the district.

Some time ago quite a sensation was caused by the announcement that sugar was to be refined by electricity. The report at the time was treated somewhat sceptically, but it is now asserted that work will actually be done in this line. The Electric Sugar Refining Company of New York is said to be getting its plant ready for manufacturing in Brooklyn, using what is known as the "Friend Process." It is claimed that this system will convert a ton of raw sugar in 2 hours into perfectly hard white sugar at a cost of 80 cents per ton.

It is anticipated that the first train will run over the Forth Bridge in October 1889. Major-General Hutchinson, in his nineteenth quarterly inspection of the work, states that the average number of men employed per diem during the quarter has been 3,790, and that the quality of the work, as far as can be judged, is excellent.

Mr. S. Terry lately read a paper on "Street-watering with Sea-water" before the Civil and Mechanical Engineers' Society. The author commenced by giving the chemical constituents of sea-water, noting that owing to the delequescence character of the chloride of magnesium that any material (having been once moistened with sea-water) remains moist. Particulars of thirty-five towns where sea-water was used in street-watering, which had been collected by the Borough Surveyor of Ipswich were then referred to, and the general tendency of the evidence in its favor noted. In one case it is stated that sea water tends to produce gas when it meets sewage, and therefore should not be used for flushing except in large volumes. One authority states that one cart of sea-water is equal to 2 carts of fresh water in street-watering, while the Borough Engineer of Portsmouth, Mr. Boulnois, puts it as equal to 3 carts of fresh water. Particulars are given of the works at Hastings and Little Hampton, and Great Yarmouth giving their several costs. Included in the paper are details of modern street-watering carts. In the discussion which followed the advantages rather than the disadvantages were spoken of.

A paper entitled *The Economy of health in Engineering Workshops* was recently read before the Manchester Association of Engineers by Mr. Corbett. The author divided the subject into four departments—(1) Ventilation and Heating (2) : Lighting by Daylight or Artificial Light : (3) Water-supply : Dining-rooms : (4) Sewering and Waste Appliances. He urged that healthy workshops were the most comfortable, so getting a repute amongst workmen and getting filled with contented men. He stated that each man should have at least 25 square feet of floor area, and at least 400 cubic feet of space for comfortable ventilation. The various heads of his paper were dealt with and the paper was well illustrated.

The Royal Meteorological Society intend to hold an exhibition of apparatus connected with atmospheric electricity including lightning conductors, photographs of lightning, and objects damaged by lightning, to be held at the Institution of Civil Engineers from the 20th to 23rd March. There will also be exhibited new meteorological instruments invented or first constructed since last March.

RAILWAYS IN CHINA.

(From our own Correspondent.)

In accordance with your expressed desire, I venture to send you all the reliable information I have been able to obtain on the subject of railways in China, and which is as follows.

In the year 1864 the important official centres of Soochow and Nanking, having been recovered from the Tai-pings, it was generally believed by foreigners residing in Shanghai, that the Imperial Chinese Government would immediately open those places to foreign trade, and on the strength of that simple supposition, many persons went so far as to buy land in Soochow, and others built their hopes of future prosperity on the prospects of having a railroad to connect Shanghai with Soochow as a commencement of what was to follow. Things were thus actually carried so far, that General Stephenson, or some other railway authority, was induced to come out to China, with a working miniature model of a railway, which was exhibited in various places, including Peking I believe, to the native officials, with a view of persuading them to grant a concession for the building of a regular railway as a sort of experimental undertaking, with a view to greater things in future.

Plans and estimates for a line from Shanghai to Soochow were also prepared, and brought to the notice of the officials, but the country was not prepared for such an innovation, and the nation was ignorant of its value, as well as indifferent to the beneficial results likely to be derived therefrom, and great was the disappointment of foreigners when it became known that the Chinese Government had decided to postpone the building of railways in China, until the Emperor Tung-Cih, then a minor, was of age and firmly established on the throne of his ancestors. Meanwhile the restoration of Imperial rule in the whole of this Kiang-Su Province became the signal for the return of the people, who had taken refuge in Shanghai during the civil war, and the occupation of their homes by the Tai-pings. The exodus of the natives left houses unoccupied, and fields untilled in Shanghai; household property and land were soon down to a low figure.

Failures amongst foreigners were numerous, and many long-established and highly prosperous firms found it necessary to withdraw from business in Shanghai.

Nothing more was said of railways in Shanghai; the subject was in fact lost sight of for a long time in the midst of the general confusion that followed on the restoration of order throughout China generally, and peace then appeared to be anything but a blessing to many.

In 1874 the Japanese invaded Formosa to the great astonishment of the Chinese Government, who had supposed such an invasion impossible by the Japanese. General Liu Ming Chuan, who was then living in retirement, was called out to expel the invaders, but Liu declined to come out, unless the Government sanctioned the building of a railroad from Peking to Chin-Kiang Treaty Port, on the Yang-tze. The subject was placed before the high Provincial authorities, who, one and all, excepting Li Hung-Chang, I believe, voted against the innovation. I have personally always supposed H. E. Li Hung-Chang the actual originator of that plan of railway to Chin-Kiang. Unable to drive out the Japanese from their occupation, the Central Government decided to buy them off, and acted accordingly. But the want of steam transports was no doubt seriously felt, and some enterprising

persons managed to induce the Imperial Government to foster the endeavors of the China Merchants Steam Navigation Company, to organize its fleet of steamers in a substantial manner, which was done to a certain extent.

Meanwhile the young Emperor had become of age, and was to be married, and some British manufacturers and capitalists got imbued with the idea that a short line of railway and carriages would prove an acceptable present to the Emperor.

Twelve or fifteen miles of rails with a suitable amount of rolling stock was accordingly got ready and dispatched to China, offered to the young Emperor, through the British Minister and the members of the Chinese Foreign Office, or the Tsung-li Ya-mèn. The gift was politely, but firmly, declined, and in order to be saved the mortification of carrying it back to Europe, permission was obtained to lay the line between Wu-lung and Shanghai, a distance of about 12 miles.

The line appears to have proved highly popular amongst the natives, and satisfactory to the proprietors, who derived a considerable amount of revenue therefrom. Some of the high Chinese officials were, however, displeased at the introduction of railways, despite their efforts to prevent such, and they spared no pains to try and persuade all influential officials to have the authority for running the Wu-lung Railway withdrawn from its promoters, and proprietors. These latter on the other hand being delighted with the success of their first short line, endeavoured to obtain another concession to extend the line as far as Soochow, and were so near securing their object, that Mr. Mayers, the Secretary of H. B. M.'s Legation at Peking, who was entrusted with the duty of pressing the matter near the Viceroy Shên at Nanking, actually wrote to me on the subject offering me an important position in connection therewith, on the authority of a person whom it is not necessary to name.

The Anti-Progressive party was, however, too powerful, and having effectually frustrated all attempts at obtaining permission to extend the railway to Soochow, next set to work to get rid of what had already been laid between Wu-lung and Shanghai.

The line was bought up by the Chinese officials for Tls 280,000—a pretty good price for the article—and at the expiration of the first twelve months since its inauguration, the line was ruthlessly, and wantonly, torn up and shipped to Formosa, where it has lain uselessly ever since. No doubt but that many officials regretted this step, especially General Liu and Viceroy Li, who had sought the permission of the Government to lay a line between Peking and Chin-Kiang. Some time after that permission was granted to the China Merchants' Steam Navigation Company to open coal-mines in various places. One was opened in Formosa, and worked for some time under the direction of foreigners, and it was intended to use the discarded Wu-lung Railway to carry the coals from the mines to a port for shipment. Mining operations were, however, stopped before the railroad was begun, and so ended the matter for the time being. A coal-mine was, however, opened at Kai-ping or Tang Shan, Chih-Li Province, and everything therewith carried on in first class style, but the mine being some distance from a port of shipment, it was found difficult to get rid of the coal. Permission was then obtained by the Kai-ping Coal Mining Company to build a short line of railway for the transport of coal from the mines to a place called Hsü-Ko-Chuang, a distance of about seven miles only. The line was laid, and has been running very quietly ever since. The Franco-Chinese war then broke out in Tungking, and the use of the telegraph was extensively called into requisition.

The lack of means for transporting troops and war material in a rapid manner was then seriously felt, and taking advantage of the occasion, I found means to bring the subject to the notice of the late Minister and Viceroy, H. E. Tso Tsung Tang, who then looked at the matter in a favorable light, and in his last memorial to the Throne recommended the introduction of railways as a means of defence, if nothing else, to the Imperial Government. Acting on this powerful recommendation, permission was sought to extend the Kai-ping Railway from Hsü-Ko-Chuang to Yen Chuang, also called Lu-Tai, a distance of twenty-two or twenty-three miles. The Imperial permission was granted, and a company was then formed to undertake the work with the title of the China Railway Company, and a capital of a quarter million of taels,

(To be continued.)

SONTHAL PERGUNNAH.

BEFORE leaving this part of the country where I have been prospecting during the past six months, I beg to send a few notes which were made by me during my excursions and shall be glad if you can give them space in your paper. The matter is worth consideration as it will be opening out a country which has hitherto been unknown and stagnated owing to its resources not being developed for want of facilities—i.e., communications.

AGABEG AGABEG.

NOTES ON CONSTRUCTION OF A TRAMWAY LEADING TO DOOMKAH FROM DEOGHUR.

DOOMKAH (Head-quarters of Sonthal Pergunnah District) has become a place of great importance. There are three main lines of communication between this and the outside world—viz., Doomkah and Rampore Haut, Doomkah and Soory, and Doomkah and Deoghur roads. The last named route is 41 miles long, having an uniform width of 20 feet. It is metalled and bridged throughout, except where it crosses the river More in its upper stretch at a place called Mahasoo, 5½ miles from Doomkah. The large number of masonry bridges which have been recently constructed on this road are warranted to be sufficiently strong to allow even heavy locomotives to run on at usual speed. The gradients and general alignment of the said road are not other than what is adopted in several metre-gauge lines made in this country. These favorable points tend to establish the fact of there existing a ready made road for a tramway (of any gauge) to be laid at once. The more tempting feature about this line of road is the greatly increasing traffic it has been attracting since its construction some six years ago. I believe the last statistics taken of traffic on the several roads in the District show the number of laden carts on this road to be 400. Assuming the lowest load in a cart to be 10 maunds, the Deoghur road is thus shown to be carrying on a brisk traffic in several country and foreign goods approximating 4000 maunds a day. There being two Hindoo temples of far and wide fame to which vast concourses of people resort from all parts of Hindoostan in all seasons of the year, situated on this line of road, it is premised that should a tramway line be run on it, a large passenger traffic could also be secured. These two inciting facts if brought home to any enterprising people would lead them to launch out in the undertaking—viz., joining Doomkah and Deoghur by an iron road.

A bridge over the river More, which I have recorded above as the only unbridged stream in this road, is in no wise a difficulty. There are favourable features regarding this crossing, tending to a very easy construction either of an arched bridge or an iron girder one over it. The stream has a catchment basin of some 300 square miles; the velocity thereof is not more than 12 feet per second. It is further confined by bold perpendicular banks never having been scoured. The stratum 7 or 8 feet beneath the bed is hard rock, forming the best possible thing for a foundation.

The bridges here, of which the number is legion, are constructed entirely of rubble masonry and have been certified to, by one and all inspecting officers as more durable and strong than those made of first class brick masonry. The bridge over the said river could thus be constructed of rubble masonry abutments and piers and a superstructure made of iron girders and joists at a cheap cost say.—

Rs. 30,000 which I arrive at thus:—

1. Rubble masonry	...	Rs. 7,000
2. Girders and other iron materials	...	18,000
3. Minor items	...	5,000

Total Rs. 30,000

A bridge of 10 spans of 40 feet each need only be erected which will take in the whole section of the stream at this crossing from the East steep bank 12 feet high to the other one on the West.

The tramway proposed would instead of being a new idea turn out in reality to be an extension to Messrs. Burn and Co.'s line from Baidyanath (a station on the chord line of the East Indian Railway) to Deoghur, a distance of about 4 miles, and which is being successfully worked by them since about 1884. We could not have other than metre gauge, should we tend to bring about a full realization of the idea hinted at above. Another incentive to the adoption of this gauge is the avoidance of many disadvantages attendant on a break of gauge. A further one is the positive chance of excluding for a time the heavy item of cost required for the purchase of requisite rolling stock from the estimate for the construction of the proposed tramway line, as Messrs. Burn and Co. could lend us their rolling stock of which they have more than they want for some time, of course for a consideration.

It indeed seems a wonder that this line, presenting as it does so many advantages, remains unconstructed up to this time. The construction further does not involve a large outlay. The whole thing could be got up at a cost of Rs. 3,50,000 including the erection of the More Bridge. The figure however excludes the item of expenditure under the head "Rolling stock." Could this tramway be made, it would doubtless immensely benefit the several local zemindars. The value of their estates would then be considerably enhanced; the several rich mines on their estates could be worked up to very great advantage; their forest produce, which now does not fetch any price whatever, would then find a ready outlet to Calcutta market; their timber, of which they have got an abundance, would be saleable at very much higher rates; and in fact manifold advantages would accrue to them by the bringing in a tramway to Doomkah.

The initial cost I have proved conclusively is comparatively a trifle and the lucrativeness of the business is indeed great. Should the necessary capital be forthcoming, the work could be taken in hand at once and brought to completion in the course of a year.

A. A.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, March 3, 1888.

With reference to *Gazette of India*, Military Department, Notification, dated the 10th February 1888, Honorary Lieutenant and Deputy Assistant Commissary W. Marr, Assistant Engineer, 1st grade, Toungoo Division, proceeding on furlough on medical certificate to Europe, availed himself of the subsidiary leave granted him on the afternoon of the 25th February 1888.

Bengal, March 6, 1888.

The following promotion and reversion are ordered:—

Mr. J. J. Whiteley, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 8th February 1888.

Mr. J. J. Whiteley, Executive Engineer, temporary rank, 4th grade, to be Assistant Engineer, 1st grade, permanent, with effect from 23rd February 1888.

The following transfer is ordered:—

Captain L. Langley, R.E., Executive Engineer, 2nd grade, sub. *pro tem.*, from the office of the Chief Engineer for Irrigation to the VI. Circle for charge of the Trichinopoly Division. To join at the public expense.

The following intimation received from the Secretary of State is published:—

Mr. J. C. Larminie, Executive Engineer, 2nd grade, Madras, permitted to return to India to spend the remainder of his leave there.

India, March 10, 1888.

Major W. W. B. Whiteford, R.E., Executive Engineer, 2nd grade, State Railways, is temporarily transferred to the Punjab for employment on the Patiala-Bhatinda Railway.

Mr. A. Penny, Executive Engineer, 1st grade, State Railways, is, on return from furlough, temporarily attached to the Office of the Consulting Engineer to the Government of India for Railways, Lucknow.

Mr. J. Wallace, Executive Engineer, 4th grade, sub. *pro tem.*, Burma, reverted to his substantive rank of Assistant Engineer, 1st grade, with effect from 9th August 1887.

The services of the undermentioned officers are temporarily placed at the disposal of the Military Department, for employment in the Military Works Department, with effect from the dates specified:—

Major H. H. Cole, R.E., Executive Engineer, 1st grade, Central India, from 31st August 1887.

Lieutenant E. Houston, R.E., Assistant Engineer, 2nd grade, Hyderabad, from 8th August 1887.

Lieutenant C. H. Cowie, R.E., Assistant Engineer, 1st grade, State Railways, from 16th September 1887.

Lieutenant W. R. Hilliard, R.E., Deputy Examiner, 2nd grade, Punjab, from 3rd August 1887.

This cancels Public Works Department Notification of 4th November 1887.

Mr. J. Mackenzie, Honorary Assistant Engineer, 2nd grade, Burma, is retransferred to the Punjab.

Mr. H. Bell, Manager and Engineer-in-Chief, Tirhoot State Railway, is granted furlough for 7½ months, with effect from the 25th March 1888, or such subsequent date as he may avail himself of it.

Captain H. G. Kunhardt, R.E., Executive Engineer, 2nd grade, State Railways, is transferred from the Establishment under the Director-General of Railways to that under the control of the Government of Bengal.

Baluchistan.

Mr. H. Phillips, Assistant Engineer, 1st grade, is transferred from the 2nd to the 1st Division, Frontier Road.

Rajputana.

The Agent to the Governor-General for Rajputana is pleased to grant furlough for twelve months to Mr. Campbell Thomson, Executive Engineer, Meywar State, with effect from 1st April 1888, or any subsequent date on which he may avail himself of it.

Director-General of Railways.

Mr. F. D. Fowler, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India, an extension of seven months' furlough, in continuation of the twelve months granted him in Director-General's Notification, dated 12th February 1887.

With reference to Public Works Department Notification, dated 29th February 1888, Mr. F. J. E. Spring, Executive Engineer, 2nd grade, is posted to the North-Western Railway.

N.-W. P. and Oudh, March 10, 1888.

Irrigation Branch.

Mr. J. A. Cones, Executive Engineer, 4th grade, temporary rank, is transferred from the Aligarh to the Anupshahr Division, Ganges Canal.

Mr. G. T. Barlow, Assistant Engineer, 2nd grade, is transferred from the Northern to the Aligarh Division, Ganges Canal.

Mr. E. A. Carswell, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent, *vis* Lieutenant Colonel Skipwith, R.E., promoted to Superintending Engineer, 3rd class, permanent, from 8th November 1887.

Mr. A. C. Evans, Executive Engineer, 4th grade, sub. *pro tem.*,

to be Executive Engineer, 4th grade, permanent, *vice* Lieutenant-Colonel Skipwith, R.E., promoted to Superintending Engineer, 3rd class, permanent, from 9th November 1887.

Mr. H. M. J. Bacon, Assistant Engineer, 1st grade, sub. *pro tem.*, to be Assistant Engineer, 1st grade, permanent, *vice* Lieutenant-Colonel Skipwith, R.E., promoted to Superintending Engineer, 3rd class, permanent, from 9th November 1887.

Mr. A. C. Evans, Executive Engineer, 4th grade, to Executive Engineer, 3rd grade, sub. *pro tem.*, *vice* Mr. Carswell, permanently promoted, from 9th November 1887.

M. J. H. A. Ivens, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, *vice* Mr. Evans, from 9th November 1887.

Buildings and Roads Branch.

Mr. E. Hodges, Executive Engineer, 2nd grade, Divisional Engineer, Allahabad, is granted leave on medical certificate for twelve months.

The following postings and transfers are ordered in the interest of the public service:—

Mr. R. C. Battie, Executive Engineer, 2nd grade, District Engineer, Bijnor, is posted to the charge of the Allahabad Division Provincial Works, *vice* Mr. E. Hodges, granted furlough on medical certificate.

Major G. M. Bellasis, Executive Engineer, 2nd grade, Divisional Engineer, Jhansi, is posted to the charge of the Lucknow Division Provincial Works, *vice* Mr. J. W. Alexander.

Mr. R. J. Powell, Assistant Engineer, 1st grade, attached to the Ranibagh-Ranikhet Cart Road, is transferred from the 2nd Circle to the 1st Circle, Provincial Works.

Mr. G. J. Joseph, Executive Engineer, 3rd grade, District Engineer, Allahabad, is posted to the Meerut District as District Engineer.

Rae Sohan Lal Sahab, Assistant Engineer, 1st grade, Agra Executive Division, is transferred to the Bijnor District as District Engineer, *vice* Mr. R. C. Battie.

Rae Mohan Lal Katcha Sahab, Assistant Engineer, 1st grade, is, on return from privilege leave, re-posted to the Jalaun District as District Engineer.

Mr. A. H. Ashton, Assistant Engineer, 1st grade, is transferred from the Jalaun to the Etawah District.

Rae Mohendro Nath Chakravarti Sahab, Assistant Engineer, 1st grade, is transferred from the Allahabad to the Hamirpur District as District Engineer, *vice* Babu Aghar Lal Bose.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 7th March 1888.

206 of '87.—William Jackson, Engineer, Thorn Grove, Mannofield, Aberdeen, Scotland.—For improvements in stoves for heating air.

236 of '87.—Walter Thomson, Zemindar, of Beheea, Shahabad, Bengal, James Mylne, Zemindar, of Beheea, Shahabad, Bengal, and James Bingham Alliott, Engineer, of Nottingham, England.—For improvements in centrifugal machines or spinners for draining sugar and other purposes.

WANTED AS GENERAL FOREMAN.

A STEADY man possessing a good general knowledge of Mechanical Engineering, Iron Founding, &c.

For terms of engagement, salary, &c., apply, forwarding copies of certificates, to

ROBSON & Co.,
Mayo Road, Lahore.

WANTED BY THE S. I. R. COMPANY.

ENGINEERS AND SURVEYORS.

EXPERIENCED IN SURVEYING, LEVELLING and laying out Railways. To competent men employment can be insured up to end of August next. Apply, stating antecedents, age, experience, and salary expected, to the undersigned.

DAVID LOGAN.

Chief Engineer, S. I. Railway.

Trichinopoly, March 17, 1888.

(89)

NOTICE.

ALLAHABAD MUNICIPAL BOARD.

WITH reference to the advertisement calling for Plan and Estimate for a Municipal Hall for this City, notice is hereby given that the Board do not wish to tie down competitors to the actual sizes of the rooms therein given as long as their areas are not decreased.

By order,

T. R. EDMONSON

Secretary, Municipal Board, Allahabad.

ALLAHABAD, 29th February 1888.

A GREAT WANT SUPPLIED.

No Package Genuine
without this Trade
Mark.



No Package Genuine
without this Trade
Mark.

Registered 14th October 1878.

CYLINDER OIL.

TURNER, MORRISON & Co., Calcutta,

Sole Agents for Bengal.

(93)

WANTED IMMEDIATELY

A SECRETARY for the Umballa District Board. He must possess the following qualifications:—

(1) A fair knowledge of English; (2) experience in the business of a District Office; (3) experience (as a Tahsildar or otherwise) in the practical supervision of Public Works. Salary Rs. 200 a month with travelling allowance at the rates allowed to Extra Assistant Commissioners. A retired Tahsildar preferred.

Apply, with copies of testimonials (original sent will not be returned) to—

THE DEPUTY COMMISSIONER, Umballa City.

PROSPECTUS OF

THE NAINI TAL WIRE-ROPE-WAY CO., "LD."

REGISTERED UNDER THE INDIAN COMPANIES' ACT OF 1882, where the liability of each Shareholder is limited to the amount of his shares.

Capital, Rupees Two Lacs (with power to increase) Divided into 2,000 Shares of Rupees 100 each.

Payable as follows:—Rs. 10 on application, Rs. 15 on allotment, and the balance as required after giving one month's notice; calls not to exceed Rs. 10 per share.

PROVISIONAL DIRECTORS.

S. Hanna, Esq., C.E.

F. E. G. Matthews, Esq., Builder and Contractor.

D. Lancaster, Esq., Manager, Rohilkund and Kumaon Bank, Limited, Naini Tal.

C. Phillips Esq., Messrs. Murray & Co., Naini Tal, (with power to add to their number.)

BANKERS.—The Rohilkund and Kumaon Bank, 'Limited,' Naini Tal, Bareilly, and Cawnpore

MANAGING DIRECTOR.—(PRO TEM.) S. Hanna, Esq., C.E.

SECRETARY.—(PRO TEM.) D. Lancaster, Esq., Manager, Rohilkund and Kumaon Bank "Limited."

The Company has been formed for the purpose of carrying Goods, Stores, Baggage, Mails, Produce, Material, &c., from Naini Tal to Kathgodam, and *Vice Versa* with intermediate stations by means of a Wire-Rope-Way driven by water power.

Wire Rope-Ways have been in existence for some years in many parts of the world, and have worked satisfactorily and with profit, and there are excellent grounds for believing that the proposed Wire-Rope-Way will prove a great success and yield a good profit to Shareholders.

The time occupied by carts from Kathgodam to Naini Tal is three (3) days, the cost per maund being 8 annas, by the direct route, and by means of coolies the time occupied is from six (6) to eight (8) hours and the authorised rate is Rs. 1 per maund, the time occupied by the Wire-Rope-Way will be three (3) hours and the average cost (5) five annas per maund, so that the saving in both time and cost will be considerable, besides which there is the avoidance of all annoyance and delay in obtaining coolies at the starting stations.

The cost of the Wire-Rope-Way is estimated, including working capital at Rs. 1,80,000, which amount it is proposed to call up gradually as already stated, viz. —Rs. 10 per share on application, Rs. 15 per share on allotment, and the remaining Rs. 75 per share as required by calls not exceeding Rs. 10 each on giving one month's notice.

The Projector has gone into the matter completely, and estimates the Traffic, based on the Municipal returns and official sources, at not less than 2,00,000 maunds per annum, and there is every reason to expect that this quantity will be exceeded from the rapid extension of this favourite summer retreat.

The average rate per maund is 5 annas, at which 2,00,000 maunds would yield Rs. 62,500, from which, deducting estimated repairs and working charges, Rs. 37,500 would leave Rs. 25,000 yearly, which would yield a Dividend of 12½ per cent. on Rs. 2,00,000. If the issue of capital be fixed at Rs. 1,80,000, the profit would be nearly 14 per cent. That yield is expected, assuming cost of working, maintenance, and repairs to be the same as those stated in the estimate, but the Projector believes that it will be possible to reduce those charges without detriment to the working of the line.

Naini Tal, affording an ample water-supply, offers every facility for working the line at a minimum cost.

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(91)

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Sales by Public Auction will be held as under of scrap, cast and wrought iron and other metals, old rails of sorts and sizes, steel tyres, steel crossings, old sleepers, miscellaneous firewood, and packing cases, old iron and wooden gates, doors and windows of sorts and sizes, old blacksmith's bellows, cast iron girders, fog-signals, bazar weights, office furniture, roofing iron work, stoneware pipes and other stores, including a quantity of condemned medical stores.

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2. Jamalpore on the 5th "
3. Dinapore on the 9th "
4. Allahabad on the 12th "
5. Cawnpore on the 16th "
6. Ghaziabad on the 20th "
7. Delhi on the 23rd "

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CALCUTTA ;
9th March 1888. }

(88)

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(85)

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Applications, with copies of testimonials, will be received up to 26th March 1888.

HERAMBHO NATH DASS,
DISTRICT ENGINEER.

MYMENSINGH, 3rd March 1888.



P. W. D. NOTICE.

Tenders are invited for the execution of ordinary repairs to Government buildings in the Calcutta Circle, during 1888-89.

Separate tenders should be submitted on printed forms to be obtained at the Office of the Superintendent of Works for Buildings in each of the Sections noted below :—

No. 1 Section.—All Buildings east of Cornwallis Street, College Street, Wellesley Street and Wood Street, excluding the Surveyor General's Office.

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No. 3 Section.—All Buildings lying between the above and the Strand Road, except No. 3, Church Lane.

No. 4 Section.—All Buildings (except Belvedere Buildings) situated in Alipore, Kidderpore and Russa.

No. 5 Section.—All Buildings situated in Dhollandah including the Presidency Jail.

Tenders will be opened by the Superintendent of Works, at his office on the following dates :—

For Sections No. 1 & 4 on Tuesday 20th March at 3 P.M.
" " " 2 & 5 " Wednesday 21st " " 3 P.M.
" " " 3 " Thursday 22nd " " 3 P.M.

WRITERS BUILDINGS, } G. F. E. S. NEILL, LIEUT.-COL., M.S.C.,
CALCUTTA ;
The 8th March, 1888. } Superintendent of Works, Calcutta.
(92)

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OF

Valuable Leasehold Property in Bombay.

Preliminary Announcement.

To be sold by Public Auction, on a day to be hereafter fixed (unless a suitable offer is previously obtained by Private Contract) by order of the Mortgagee and on account and risk of the Official Assignee as the Assignee of the estate and effects of James Donald of Bombay, the whole of the valuable property known as the Ripon Iron Works, situate at Frere Road, Bombay, with all the machinery and fittings used in connection therewith.

For further particulars and conditions of sale apply to the Undersigned, Solicitors to the Mortgagee.

TOBIN AND ROUGHTON,

70, Tamarind Lane,

BOMBAY.

(83)

TO BE SOLD.

BY Public Auction to the Highest Bidder on Monday, the 19th day of March 1888.

BY

Messrs. MACKENZIE LYALL & CO.

Under instructions from Baboo Ramkissen, the Official Liquidator of the Imperial Ice Company, Limited, under an order for that purpose obtained by him from the High Court, dated the 23rd day of February last, at the Company's Ice Factory at Bhowanipore aforesaid, the whole of the machinery and plant of the said Imperial Ice Company, Limited, (viz):—

Valuable Ice-making Machines together with Pumps, Tanks and other necessaries for carrying on an Ice Industry.

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THE Acting Agent will be prepared to receive at his Office, Victoria Terminus, Bombay, up to 1 P.M. (Gunfire) on Wednesday, the 28th proximo, Tenders for the purchase of the following old Rails double headed Section 68lbs. to 85lbs. per yard.

VIZ:—

2,100 tons Old Iron Rails in various lengths from 12ft. to 26ft.

100 tons of pieces of Old Rails 10ft. and under.

100 tons of pieces of Steel Rails.

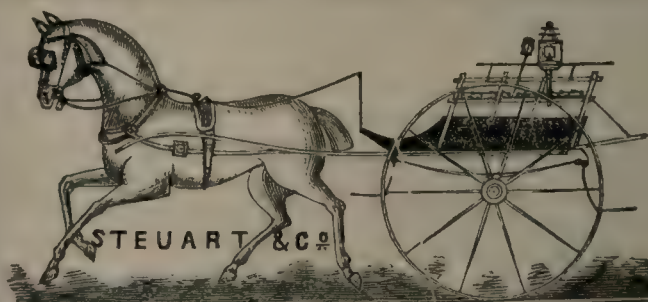
The same are now lying on the Company's premises Wari Bunder, Mazagon, Bombay, and may be viewed on application to the Wharf Superintendent.

Offers (which must be made on the Company's form to be obtained from the undersigned) must specify the quantity required the rate per ton weighed over on the spot, and the period within which delivery of the Rails will be taken.

Delivery will be made by the Company into Barges to be provided and placed by the purchaser alongside the Wharf. Payment must be made at the time of delivery.

The Acting Agent reserves the right to reject any or all of the Tenders. STOREKEEPER'S OFFICE, PAREL;)
(70) 20th February 1888.)

ALFRED KING,
Storekeeper.



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[29]

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Obituary.

BRADLEY.—Off Saugor, on 29th November 1887, Henry Charles Bradley, of the P. W. Department, aged 36 years.

BARNFATHER.—At Tunbridge, on 20th February, W. Barnfather, P. W. D., Bengal, retired.

EDITORIAL ANNOUNCEMENT.

Several Letters and Articles are held over for want of space.

INDIAN ENGINEERING.

SATURDAY, MARCH 24, 1888.

THE BOMBAY P. W. D.

WE learn on good authority that all the proposals of the Bombay Government for the reorganization of the Public Works Department have been accepted by the Government of India. We are assured that the course followed by Lord Reay throughout was not dictated by personal motives and that he was actuated purely by a desire to secure efficiency and economy. Be this as it may, we are sorry to find that he has gained his point. His object has been to separate the Chief Engineership from the Secretaryship, and this he has succeeded in doing. We have always protested against the innovation, and have already recorded our views on the disadvantages of a dual system of Departmental Administration.

We are, however, immediately concerned with the result as regards Colonel Goodfellow, and here we find that Lord Reay has not been made to eat the leak—contrary to what we wished and expected. Colonel Goodfellow gets the Chief Engineership, First Grade, but will not hold the Secretaryship. This is what was originally offered him. There are other changes, some of which we anticipated. The Chief Engineership of Irrigation is to be abolished, and thus frustrate the hopes of many in the Irrigation Branch of the Department who naturally looked to this eventuality in their Service.

We are not permitted to say more on the subject at present. The proposal will soon see the light of day. In the meanwhile we are not disposed to give Lord Reay credit for all the good intentions in this matter to which his friends and admirers consider him entitled.

BENGAL ADMINISTRATION REPORT, P. W. D., 1886-87.

THE official year which closed on the 31st March last, was a busy one in the Public Works Department, both in the Imperial and Provincial services. Great activity was manifest in all its branches, and the report records details with a minuteness which leave nothing to be desired. The outlay of the year under review on Civil and Military Works amounted to Rs. 78,26,784, distributed as follows:—Imperial Military Works, Rs. 53,928, Imperial Civil Works, Rs. 5,10,257, making a total of Rs. 5,64,185; while under the head of Provincial Expenditure the total is Rs. 38,85,400, and the local funds make up the balance, Rs. 33,77,193. A noticeable feature in the accounts is that under the head of Imperial Military and Civil Works, the outlay has fallen short of the grant under every head, representing a saving of Rs. 13,415; whereas in the Provincial expenditure, it exceeded the revised estimate by Rs. 5,65,406. The excess is mainly accounted for by the adjustments in the accounts of the expenditure on the Burrakur Iron Works from 1882 to 1887, the latter, it should be remembered, was the last of the five-year Provincial Contract, which commenced on the 1st of April 1882 coincident with the

beginning of Sir Rivers Thompson's government and the introduction of the contract system. If, however, the large amount mentioned above, which was not provided for in the Budget or the subsequent revised estimates, be eliminated the excess is represented by Rs. 10,403. A sum of Rs. 11,716 and of Rs. 1,01,189 were expended from contributions under Imperial and Provincial services, against the revised estimates of Rs. 14,981 and Rs. 94,762, respectively. The expenditure on Original Works (Provincial) shews an increase of about seven-and-a-half lakhs, which occurs under the head of Civil Buildings, against the actuals of 1885-86. We regret to observe that the Burrakur Iron Works give very unfavourable returns, on the one hand the demand for pig-iron had fallen off, and on the other its stock rose from 677 tons at the beginning of the year to 3,683 tons at its close. Denham-Olpherts' sleepers, which are manufactured at the foundry, were not in requisition, and the work there was consequently slack. There was some compensation, however, for this loss by an increase in the orders for miscellaneous castings, but as they do not consume much iron the diminution in the stock was not appreciable. Our readers will remember that the year 1886-87 was an exceptional one for heavy floods. Curiously enough their ravages were not only confined to some of the districts in Behar, but Rampore-Beauleah and even far off Tipperah suffered from them. The P. W. D., however, were equal to the occasion, and all that could be done to prevent extensive damages was successfully adopted. In regard to Irrigation the total capital expenditure, not charged against revenue to the end of the year under notice, amounted to Rs. 5,75,63,328, against sanctioned estimates aggregating Rs. 6,93,74,384, leaving an unexpended balance of Rs. 1,18,11,056 at the close of the year. This is made up by the Orissa Canals, Rs. 88,88,440; Midnapore Canals, Rs. 54,776; Hidgelee Tidal Canal, Rs. 22,790 (the excess being represented by loss of exchange); Sone Canals, Rs. 28,90,630. Agricultural works next come on for a share of attention. They embrace a very large series of works with complicated accounts. Under the head of Receipts we find that the Government embankments (Imperial) and the Tuccavee embankments under contract (Provincial) amount to Rs. 7,919, against Rs. 9,601 for the previous year—the charges under the same heads come up to Rs. 6,43,381, against Rs. 8,63,073 in the previous year. Taking the Orissa Canal, the Budget estimate for capital outlay during 1886-87 was Rs. 6,40,000, but in anticipation of short outlay the revised estimate was reduced to Rs. 5,48,000. In the Midnapore Canal the amount of estimate sanctioned by the Secretary of State for India was Rs. 83,41,769, expenditure during the year Rs. 4,856, total to end of 1887, Rs. 82,92,527, leaving an unspent balance of Rs. 49,242; less receipts on capital account Rs. 5,534, giving a net total of unspent balance of estimate Rs. 54,776. The largest traffic on the Hidgelee Tidal Canal for the quinquennial period 1882-87, was in 1883-84, viz., Rs. 36,42,029, and the lowest in 1882-83, viz., Rs. 23,88,244, that for 1886-87 takes the third place with Rs. 31,48,826, the tollage being in the same proportion. The principal Imperial Agricultural Works under-

taken were the Surpai and the Bullu Bheel Drainage Works besides embankments of 1,122 miles in length. The Provincial Works under this head, of which the cost is in the first instance provided by Government, but afterwards recovered by the District Officers from the zemindars benefitted, are the Howrah Drainage, the Rajapore Drainage, the Dancoona Drainage, the Tuccavee Embankments under contracts, and those not under contracts. In the Sone Circle the expenditure was Rs. 8,14,062, against Rs. 8,01,208 in 1885-86. The gross area commanded by the canals is 1,728,509 acres of which the culturable area is said to be 1,350,396 acres, and the area that can be irrigated with reference to the supply of water is 1,016,400 acres. During the year under notice there was no high flood in the Sone. The flood of the river Kao at the aqueduct in October 1886 was the highest known since the construction of that work in 1875. The river Poonpoo, which crosses the railway line from Patna to Gya, is said to have risen higher than has been known for 20 years. The expenditure for maintaining the works of the Sone Canals during 1886-87 was Rs. 5,81,461, against Rs. 5,52,370 in 1885-86.

FORESTRY IN MADRAS.

I.

WE have before us two Progress Reports on Forest Administration in the Madras Presidency; one for the Northern Circle, one for the Southern. Colonel Campbell Walker is responsible for the latter which runs to a length of 32 pages without appendices. The name of the author of the former is not given; but he manages to give all the information needful in 13 concise pages. Happy thought! Might not anonymity lead to some curtailment of the inordinate length of departmental reports, some gain of economy, in time as well as money? Having preferences for economy we will to-day consider the Progress Report of the Northern Circle. *Apropos*, here is a wrinkle for severe economists who are by way of laying down one strict ratio of pay for all the world. Demarcation work, we are told, proceeded well in Ganjam, Godavari, Kistna, Cuddapah, Bellary, etc.—and then—"the cost of demarcation varies not only from district to district, but also in the different parts of the said district; for it depends so much upon the nature of the tract, number and description of cairns or posts erected, width of line cut, and the value of labor." In Kistna lines of eleven yards width were cut originally; but Mr. Homfray reduced the breadth to three yards, without sacrifice of efficiency, and with much saving of unnecessary expense. In Godavari lines of ten feet were held to be necessary. And so forth. Circumstances alter cases, in short. The boundary lines in some places have been made to serve as inspection paths and fire lines. Settlement work has not progressed well in Ganjam; and this is attributed to frequent changes of Forest Settlement Officers. It appears to us that incessant official changes are the curse of all Indian Departments. Queer leave rules and allowances, and the acting appointments that are supposed to compensate for their injustice, keep a Government servant—till he

gets into a sinecure, if he ever does—far too much on the perpetual motion trot for the interests of the Service. Then, again, Government, especially a Government working under Grant Duffian Schedules, is very apt to be penny wise and found foolish, *e.g.*, deputation of settlement work in Nellore to Divisional Officers. Until it was discovered that they had other duties, their own proper duties to attend to. Similar misappreciation of the bearings of true economy has led to neglect of Forest Survey Work. This, it seems, has not been carried on in any of the districts except Ganjam. By way of makeshift the maps published by the Survey Department have—"as far as available—" been utilized. This sort of cheeseparing must be had economy always. It is indeed the reverse of economical. In the case of a revenue winning department it is inexcusable. But things generally seem loosely arranged in Madras. How else account for the following paragraph on page 11 of the Report we are considering: "In Nellore some grazing dues were collected under leases, but the amount is not known, as they were erroneously credited to Land Revenue, and adjustment has not yet been made?"

Let us turn to something more encouraging. Ensilage, for instance. All over India the Forest Department officials are doing good work for agriculture, by supervising experiments in this direction. In Cuddapah, last year, under forest auspices, two silos were made; one of hill grass, the other of cholam stalks. Both were decidedly successful. But some prickly-pear silos essayed at the same time proved quite a failure, nothing but indigestible fibre remaining. It has been suggested "to sandwich (sic) prickly-pear with grass, so as to retain the moist portion of the prickly-pear." Bellary people are less liberal in their ideas than Cuddapah people. A silo 30' x 12' x 6' was made there, under instructions from the Director of Settlement and Agriculture, and filled with two kinds of grass. But the tide of popular prejudice set in strongly against this experiment. The silos have not been opened because there appears to be no chance of the people's using the ensuant ensilage.

In Ganjam, mahogany and *soymida febrifuga* seeds both failed. Teak and sal seeds succeeded. Seedlings of the former were sent for trial to the Berhampore fuel reserves, and of the latter to the Kistna district. In that district young trees suffered greatly from drought. In Nellore serious damage was done by the cyclone. Out of 49,285 casuarina plants put out in baskets, three-fourths were destroyed by salt water. Ironwood seedlings sown at Sriharikot suffered similarly. Mahogany cultivation has not proved a success. As to that matter it is not clearly ascertainable whether the cyclone ought to be held accountable for failure; but doubts are entertained whether mahogany can ever succeed in sand. In Kistna, ceara rubber cultivation tried on the Kondapalli and Yenapalem hills failed because the sites were too dry. In Kistna seeds of the Arabian date germinated well.

Several short district roads were constructed, and are reported very useful for timber, as well as for inspecting

officers. Rest-houses were commenced at Waddagudeim Jirigupa, and Ramaram. The Rollapenta bungalow, which fell down in 1885, is being set up again by the contractor at his own cost. The trees felled during the year gave an income of Rs. 19,657. In one way and another the Department earned Rs. 1,17,282. This is a falling off from last year's results by Rs. 27,183. The writer of the Report has come to a conclusion that in future it will be well only to use male elephants for forest work.

A CAPITAL SPEECH AND ITS SUGGESTIONS.

THE Vice-Chancellor's speech at the late Convocation of the Bombay University deserves notice for more reasons than one.

He deems somewhat more than mere formulas necessary for real education. He sees—what so few people are able to see—that technical instruction, when it is pursued on a scientific basis, affords exercise to the highest powers of the intellect, that it takes place legitimately beside and not beneath the lessons taught by a customary collegiate curriculum. And what he sees he speaks of. It is well for University Senates and College Dons, and all men who are apt to grow rusty in the traditions and vaingloriousnesses of an Academic course to be told home truths of this sort. Seldom does it happen that any man in authority has courage to kick against the pricks of conventionalism, and tell them. Rightly enough perhaps, according to its lights, the lights of bygone days, the ruling idea of a classical University is one-sided, sophistically intellectual, and nothing more. It desires to draw men away from material pursuits to scholasticism. Granted that in this there is a power that makes for civilization, a subtle humanitarian essence, worthy and commendable. But it must be granted also that all the world's intellect cannot advantageously, cannot without much prejudice to the world's well-being, be spared from aid to action. In a catholically minded University—and all Universities should be catholically minded—there should be room for utilitarian teaching, for such a course of study as may make the man who elects it more practically helpful to his fellow men than philosophical abstractions; or the niceties of verse making ever can make him. Poetry will still remain for the man who follows utilitarian teachings, the poetry of common life which is instinct like the other with a divine essence, and differs from it only in kind, and manner of adaptation to conduct. The distinguished lawyer whose speech we are considering says pertinently and truly:—"No human institution can afford to live isolated, and if a University divorces itself from the active life around it, it is pretty certain that it will very shortly become hide-bound, narrow, and pedantic, and will ultimately perish, or sink into insignificance through a kind of inanition."

Let the Universities look to it, while there is time. Meanwhile, we rejoice to find on the side of the practicality in education, we have always striven for, one more powerful advocate. Referring to the expansion of Indian

Railway systems, and commercial prosperity he urged the study of material arts and sciences and the rules and principles which underly them, and which, having been gathered from particular instances, themselves in turn form a basis, from which by induction new rules and new principles may be derived, for the world's further benefit; for humanity's gain.

The first thing wanted is a Technological Institute. The very Fates seem to smile on the idea. For, Bombay has got the money subscribed years ago for a Ripon Memorial Fund; money which, from one cause or another, has for years been lying idle in the Trustees' hands, like that Scriptural talent of silver that was wrapped in a napkin, and put away securely, and was doing no good to anyone. Lord Ripon's character points to a presumption that he would rejoice to see money subscribed to do him honor applied to further a cause so beneficent and useful as that of technical education in India. He knows well what great things it is doing for his countrymen in England. We feel sure that he would be the last man in England to begrudge the contemplated appropriation of the funds in the hands of the Ripon Memorial Fund Trustees. How better could his memory be kept green? Then there is the money subscribed for the Victoria Jubilee Technical Institute. It is hoped that ere long these two funds will be amalgamated, and that Bombay will be in a position to start an institute in connection with its University; an institute on safe foundations of endowment and income, and worthy of the capital city of Western India. The success of this experiment once established the rest of India would gradually follow it; would *have* to follow it—with greater advantage to the country, and its impoverished inhabitants than a good many of us have ever taken the trouble to think. Not merely to the tax-payer, though what man is there in India who is not, either directly or indirectly, affected by taxational burdens? Not merely to native artificers. Not merely to traders. To all. More than to any other class perhaps to that much suffering, much needing class, the Eurasian. Many of its members would most thankfully accept any opportunities vouchsafed them for adequate, useful technical instruction. Its assimilation would mean for them hope, life, gladness. Therein would the State find its advantage. For, blink the matter as we may, shut our eyes to it as hard as we can, the fact remains that Eurasians are year by year being more and more crowded out of all employment by natives, whose way of life enables them to live comfortably upon wages that would bring the Eurasian or the white man down to starvation point—that are already beginning to land him there as a matter of fact. Technical education would do much to remedy a state of affairs that threatens ere long to be a serious inconvenience, and worse, to Government. It is out of poverty, and helplessness to avert it, that modern seditions are born—the latest instance in point being the labor demonstration in Trafalgar Square that frightened Londoners out of their wits not long ago. For its own sake, if for no other reason, Government would be well advised, we take it, to pay more attention than it does, to give more encouragement than it does, to the matter of technical education.

Notes and Comments.

BUCKINGHAM CANAL PROJECT.—Revised estimates for improving the Buckingham Canal from Ennore to Chintamony backwater, amounting to nearly 1½ lakh of rupees, have been sanctioned.

SKILLED LABOR AT A PREMIUM!—The Executive Engineer, 6th Division, T. M. S. Railway Kyauksi, Burma, wants three Mason Mistrees accustomed to rubble stone work. Pay Rs. 75 per month.

AN ACKNOWLEDGMENT.—We have received a proof of Selection from the Records of the Government of India concerning the Betwa Canal Project in the N.-W. Provinces, which we hope to deal with later on.

BRIDGE ACROSS THE GADILAM RIVER AT CUDDALORE.—An estimate of Rs. 1,66,000, for constructing an iron girder bridge of 13 bays of 62 spans across the Gadilam river in the New Town of Cuddalore, in lieu of the masonry bridge destroyed by the floods of 1884, has been sanctioned.

CEYLON RAILWAY EXTENSION.—In the House of Commons, on 16th March, Baron Henry de Worms, the Under-Secretary of State for the Colonies, in reply to a question, said that the Government of Ceylon had been authorized to undertake the proposed extension of the railway from Mamoy to Haputale.

HYDERABAD (DECCAN) WATER-SUPPLY.—Mr. G. Palmer, Chief Engineer and Secretary to His Highness the Nizam's Government, P. W. D., is now engaged in drawing up a large scheme for the water-supply of the whole of Chudderghaut outside the Residency limits, affecting also the proposed supply for the City of Hyderabad.

THE MADRAS HIGH COURT BUILDING.—The Madras Government has decided that the new High Court shall be built on the Light House, Esplanade, the position which Government hitherto declined to be allowed to be built over, in consequence of its proximity to the Fort. The materials for the building will be collected immediately.

OUR BURMA ITEMS.—The Toungoo-Mandalay extension of the Burma State Railway, at present under the orders of the Director General of Railways, is to be placed under the control of the Chief Commissioner of Burma.—Colonel Peters, R.E., on return from furlough, will be transferred to Upper Burma as Garrison Executive Engineer, Mandalay.

CHEAP RAILWAY ESTABLISHMENTS.—Reports from the Agents of the Madras and South Indian Railway Companies show that the progress made in training natives of India as engine drivers and shunters for the year 1887, has been successful as compared with other parts of India, but the result must be always doubtful when the bulk of such agency cannot read either a time-table or a telegram.

THE BENGAL P. W. D. SECRETARYSHIP.—We learn that the *fiat* has gone forth, and that Colonel C. H. Luard, R.E., succeeds Colonel C. M. Browne, R.E., as Chief Engineer and Secretary to Government, Bengal. But as Colonel Luard is on leave, it is probable that Mr. Martin may act for him, failing which perhaps Lieutenant-Colonel C. W. I. Harrison, R.E., may hold charge of the office in addition to his own as a temporary measure.

THE HOOGHLY NEW BRIDGE.—The proposal for a fixed bridge over the river Hooghly has been again considered by the Port Commissioners, and it was resolved yesterday that "the thanks of the Commissioners be conveyed to

Mr. Duff Bruce for the trouble he has taken in drawing up the scheme submitted by him, but that he be informed that the Commissioners are not at present prepared to recommend the construction of a permanent bridge."

REMOVAL OF WRECKS.—The sunken flats *Borpetta* and *Byrub*, the former obstructing the waterway of the river Attarabanka, and the latter that of the Chhillpieganj, both in the Sunderbunds on the route to Assam, were blown up by Mr. John Harris, M. E., assisted by Sergeant Peck, R.E. The removal of the obstruction was complete, and the result satisfactory. The operations were carried out for the P. W. D. Bengal. We hope to furnish further particulars in an early issue.

RAILWAY CHANGES.—An early *Gazette* will probably contain notification of the change of the designation of Director-General to Inspector-General of Railways. Of the inferior establishment Mr. Hunhardt has already gone to the Tirhoot Railway, and Mr. Burt will be absorbed in the Secretariat. Captain Wilson has been retained for the present in the Stores Department of the Secretariat. Mr. Stone probably returns to the executive. Mr. E. F. Jacob, of the North-Western Railway, will be attached to the Government of India Secretariat as Traffic Expert.

A COMPARISON.—The evidence before the Public Service Commission leaves no ground for doubting that the officers recruited in England receive at Woolwich, Chatham and Cooper's Hill a professional education of a higher standard than that which the best Indian Engineering Colleges are capable of affording, and that their general training and education are superior to any attainable in India; but it is abundantly evident that at least one of the Indian Engineering Colleges can, and does, impart such a professional education as is fully adequate for the ordinary work of the Department, and that these Colleges can be made still more efficient for this purpose.

SECOND CITY OF THE EMPIRE.—A Bombay paper, referring to the opening of the new Victoria Dock, says:—We build great public works, as they are built nowhere else in the East, and when they are completed we somehow manage to ignore the efforts of the men who constructed them. In any other city in the world the opening of the new Victoria Dock or the opening of the new Victoria Terminus would have been occasions of civic rejoicing. There is something niggardly here which might very well be amended by-and-by. Good wine needs no bush, but it cannot pay in the long run to be too *chrupe*—to use a useful native word—in recognizing services that will be essentially useful to us all.

THE DALLA DOCKYARD.—The *Rangoon Times* hears that the Government has granted a new lease of the Dalla Dockyard to the Irrawaddy Flotilla. As there is no other company at present in existence in Burma, and the Government are not in a position to use the dockyard themselves, it is certainly much better to lease it to the Flotilla, who have made considerable improvements there, rather than to pursue a dog-in-the-manger policy, and do nothing with the place. But here again the Government policy is secret and bad. They should have made public the fact that the Dalla Dockyard was available for lease, when they might possibly have obtained better terms than they now have.

COMPLETION CERTIFICATES.—A sub-divisional officer may be an Executive Engineer or a Sub-Overseer, and the title is merely one of office and not of rank. It was desirable therefore that the intention of Government

should be clearly defined to prevent misunderstanding in respect to what is meant by the expression "Other officers of corresponding rank" used in the Madras Government order No. 3156 W., dated 21st November 1887, in connection with sub-divisional officers. The ruling is that the signature of any officer liable to hold charge of a sub-division may be accepted if countersigned by the Executive Engineer, and stating that the class of officers so liable is laid down in paragraph 313 of the Public Works Code.

NUDDEA RIVERS.—On a full consideration of all the facts and circumstances that have been brought to notice from time to time, the Lieutenant-Governor of Bengal is of opinion that the present system of revenue administration under the direction of the Board of Revenue and Civil Officers, coupled as it is with the necessity for audit of accounts under rules obtaining in the Public Works Department, is a source of friction inseparable from a system of dual control and opposed to the best interests of the management. His Honor is therefore of opinion that the management of these rivers should be placed under the control and management of the Public Works Department, subject to the orders of the Government in the Irrigation Branch of that Department.

INDIAN RAILWAYS IN THE HOUSE.—Mr. Slagg asked the Under-Secretary of State for India on 20th February, whether he would supply the House with details of the cost, up to date, of the railway from Sukkur to Sibi; and also of the railways known respectively as the Sind-Pishin line and the line through the Bolan Pass; also the estimated cost of the extension by means of tunnelling to Chaman. Sir J. Gorst: The cost of the line from Sukkur to Sibi was Rs. 12,93,710, exclusive of Rs. 2,94,941, the cost of the Sukkur bridge. The cost of the Sind-Pishin line was Rs. 40,55,603; of Bolan Pass line, Rs. 8,75,711; of Killa Abdullah branch, Rs. 48,351; of extension with tunnelling to Chaman, Rs. 14,08,697. The total cost of all lines and branches was Rs. 80,06,715.

RUSHIKULYA PROJECT, GANJAM.—This project is intended to utilise the waters of the small rivers, Rushikulya and Mahanadi, for the irrigation of a tract of country lying between the town of Aska and the sea, and provides for an anicut on the Mahanadi with a canal from it to the Rushikulya, so as to increase the supply of the latter, and a similar work on the Rushikulya where the Doab Canal runs in with channels to the tract to be irrigated. It includes also the formation of two reservoirs on the principal affluents of each river. The area to be irrigated is 120,000 acres, which is estimated to yield an annual revenue of Rs. 2,19,000 or a net revenue of Rs. 1,44,312 after paying working expenses. The estimates for the project which were sanctioned by the Secretary of State in April 1883 amount to Rs. 26,05,286.

COMPLIMENTARY SPECIAL TRAINS AND RESERVED ACCOMMODATION.—In future no complimentary special train is to be run on a State Railway for the convenience of any distinguished personage or high official of Government, without the sanction of the local Government, or the Director-General of Railways. Complimentary reserved accommodation is to be very sparingly granted. On this point the Manager will exercise his own discretion; but it is to be taken as an almost invariable rule that no complimentary reserved accommodation is to be given to Government officials not connected with the line, or not

travelling on railway business. Should applications for such accommodation be received, which under these rules cannot be given, the Manager should send a copy of these instructions with his reply as explaining his inability to grant the request.

STANDARD MEASURE OF LENGTH.—Mr. Scoble, in moving for leave to introduce a Bill for a legal standard measure of length in British India, said that the measure owed its origin to communications from the five Chambers of Commerce in India. While all agreed as to the advisability of having a uniform measure of length, the Bombay and Madras Chambers urge the fixing of a legal standard on the ground that under the existing law the making of false lengths in cloth goods was not punishable, and should be made so. Eighteen years ago a Bill to regulate weights and measures was introduced into the Council, but owing to the adoption of the French metre the Secretary of State vetoed it. The statement of the Bombay Chamber of Commerce might be accepted that the English yard, with its sub-divisions now so generally used throughout this country, would be the most convenient length for adoption.

THE BURMA FOREST DEPARTMENT.—Padouk timber has been found to be most suitable for parquet flooring and is thereby likely to take possession of a very extensive field of demand. It is at present being readily sold at from £9 to £11 per ton, a price which we believe yields a very handsome return to the Forest Department, who are as yet the only exporters. The *Pioneer* observes on this head that on principle there is a great deal to be said against a Government Department dealing directly in the produce of Government forests, which ought, as a rule, to be left to the trade of the country. A deviation, however, becomes excusable when, as in the present instance, it is desirable to bring a new article of trade to the prominent notice of consumers. If the sale be successful, as it is most likely to be, we trust that Government will resign its direct ventures in Padouk so soon as the timber has become one of the staple woods of the home demand.

KARACHI HARBOR.—The Chairman of the Port Trust Board, Colonel Crawford, the Collector of Karachi, made a short and telling speech in connection with the recent official inspection of the harbor works, wherein he drew attention to the work of the past year, amongst which was the opening and completion of the Erskine wharf, capable of allowing three large ocean steamers to load or discharge cargo at one and the same time; and the dredging operations which continue without ceasing, and the generally efficient state of all the works. He eulogised the efforts of the Port Engineer, Mr. Price, and his staff, also the indefatigable efforts of Captain Parker, I.M., on behalf of the harbor and its trade. The North-Western Railway works too are rapidly nearing completion, and we shall soon have a range of sheds, a godown, and a railway line running parallel with the steamers lying alongside. At the new wharf 700 tons a day can be discharged from each steamer.

THE INVENTIONS BILL.—At the last meeting of the Legislative Council this morning, the Honorable Mr. Scoble, in presenting the report of the Select Committee on the Inventions and Design Bill, referred to the suggestion made by outsiders that the time given to foreign inventors within which to apply for exclusive privilege for their inventions in British India should be extended to three years. In the Bill the time fixed was one year from the date of the grant of the patent, elsewhere than in Great Britain which, in the public interest, was a reasonable time and should not be altered. On the same ground it was

proposed to retain provision that when a patent expires in the country of its origin it should also expire in India. The Advocate-General, or any person authorised by him, or the person alleging that a patent had been obtained in fraud of his rights, could only apply to a High Court to quash exclusive privilege upon certain specified grounds. The report was received and passed.

RAILWAYS FOR SIAM.—It is generally understood in Bangkok that the mission of Sir Andrew Clarke to Siam is on behalf of a syndicate of English capitalists and contractors who were desirous of constructing railways in Siam. No concession has been granted as yet, but it is believed that arrangements are being made for a survey of the several lines proposed by the Engineers who accompany the expedition. The expense of this survey will be borne by the Siamese Government, and when it is finished, and the probable cost of the projected lines ascertained, the Government will then decide whether to go on with them, either wholly or partially, or not. There are two railways proposed, the first from Bangkok to Xiengmai, the second from Bangkok to Korat. A preliminary survey has been made, and there do not appear to be any serious difficulties in the way of constructing the lines. No estimate for the construction of the railways has as yet been made; we trust, however, that we will know about this as soon as the Government has decided that the railways should be constructed.

BOMBAY PORT TRUST WORKS.—A further advance has been made in the direction of constructing a graving dock for the mercantile marine in Bombay. At their last meeting, three rough plans of graving docks were considered by the Port Trustees, and the Engineer of the Trust recommended that the dock should have the following dimensions:—Length, 500 feet; width of entrance, 66; width of dock bottom, 70; width of top, 90; depth of sill at ordinary spring tides, 21, and at neap, 15. The scheme adopted was one opening at right-angles to the north-eastern bay and extending across Malet basin. By the adoption of this scheme most of the traffic carried on at Malet Bunder will have to be transferred elsewhere. One great advantage of this particular site is that, should the dock require lengthening at any future time, there would be no difficulty. It also affords ample room for workshops. The estimated cost is Rs. 1,00,00,000. The Engineer has been instructed to prepare detailed estimates. Messrs. Kirby & Co., having completed the new Victoria Dock in 245 days less than contract time, have become entitled to a bonus of Rs. 1,76,000.

WHAT HAS HAPPENED?—In Southern India there existed from time immemorial an institution called "Kudi Maramat," according to the laws of which the native peasantry or small farmers, with their servants or coolies were compelled to undertake so much actual labor annually in the fields. This labor was directed to the upkeep of the tank or reservoir, with the supply, drainage, or irrigation channels connected therewith, or to the protective works—dykes, flood-banks, etc. In time of emergency, such as disastrous flood, this "customary labor" was found most useful, as under its agency compulsory labor was immediately brought to bear when required; it was custom, and no one grumbled, and everybody benefited more or less. Now this custom has been allowed to fall into abeyance year by year, partly through ignorance on the part of the English rulers, partly from mistaken philanthropy and the nonsense about "slavery," and so forth, with the result that all the minor irrigation works

—and their name is legion—throughout Southern India have fallen into such a state of disrepair and ruin, that to set them in order now is an impossibility, and, even if practicable so far as the required labor is concerned, would be utterly beyond the means of the State financially.

THE ROYAL INDIAN ENGINEERING COLLEGE.—The account of Cooper's Hill during the year 1885-86 stood as follows:—

		EXPENDITURE.		
		£	s.	d.
Salaries of President, Professors, etc.,				
Wages of Servants, Provisions and				
Contingent Expenses	...	21,662	15	4
Cost of alterations and additions to the				
College Buildings	...	554	18	10
Salaries and Expenses while gaining				
practical experience in Engineering				
of Students retained in England after				
having passed out of the College...		3,745	9	2
Passages to India of passed Students		650	0	0
Total Expenditure		26,613	3	4
		RECEIPTS.		
Fees and Caution-money received from				
Students...	...	18,905	5	4
Sale of provisions, Farm Produce, etc.		845	11	2
Total Receipts		19,750	16	6

The net expenditure upon this Institution during the year in question was consequently £6,862-6-10, excluding interest upon the outlay incurred, although caution-money being repayable seems to be wrongly treated as a receipt in reduction of, or as a set off to, expenditure.

REMARKABLE CONJUNCTION OF MERCURY WITH VENUS.—A contributor to *Indo-European Correspondence*, evidently well qualified to deal with the subject, says:—The near approach of these two planets, on this day week, Wednesday morning, 28th instant, will present the amateur astronomer with a rare and interesting spectacle. The centres of the two planets will at one time be distant from each other by barely 1' 15", while their limbs will be yet nearer by nearly 10"—the sum of their semi-diameters—so that these bright gems of our sun's escort may then both be seen together side by side in the field of any telescope. Venus, as a 12 days' old, and Mercury as a 7 days' old, moon, two-thirds the diameter of its rival, and vying with it in coruscating whiteness. Of a truth, under the circumstances, the total luminosity of Venus should be to that of Mercury fully as 14 is to 10, supposing the reflective power of the surface to be the same for both planets. We have here a most favorable opportunity to institute a careful comparison, which may throw some light on that interesting point of physical astronomy.

Here are a few precise data.

Calcutta mean time.	8h. 147m. Conjunction in R.A. Apparent distance of centres 1' 38"			
	9h. 6' 2m. Nearest approach	"	"	" 1' 15"
	10h. 30m. Conjunction in δ	"	"	" 1' 55"

Mercury passing in the meanwhile from due North δ to due West (R.A.) of Venus. Of course the occurrence taking place in broad day-light can be observed only with the aid of a good telescope. However, even at early dawn, the planets will already be sufficiently near each other to render a good eyesight necessary, in order to make them clearly discernible one from the other as two distinct stars.

Current News.

AN accident recently occurred at Hamirgarh Station, on the Rajputana-Malwa Railway, in which a pointsman was killed.

THE Municipal loan of Rs. 50,000 for the extension of Bhagulpore Water-Works will probably be sanctioned by Government.

It is probable that when the Patents Bill is passed, some new arrangements may be made for the working of the Patents Office.

THE India Office has sanctioned a special pension of Rs. 6,000 per annum to Mr. H. B. Medlicott, the late Director of the Geological Survey Department of India.

THE Amritsar Municipality disposes of its town sewage and street sweepings to good account. By their sale to zemindars and brick-kiln burners it realized Rs. 35,000 in 1886-87.

THE Bengal-Nagpur Railway Agent, having completed his tour over the line to Asansol, has gone to Calcutta to confer with the Government, and will return to Nagpur *via* Allahabad next week.

THE case of Mr. Dickson, Travelling Inspector of Accounts on the East Indian Railway, against that Company for wrongful dismissal, is likely to come up soon. Plaintiff claims Rs. 75,000 damages.

THE Government of India have, it is said, ordered that kerosine oil should be used in barracks and hospitals in the Madras Presidency, instead of the vegetable oil, as being the cheaper. Wall-lamps and not hanging ones are to be used.

MAJOR BOUGHEY will next week resume the Managership of the Eastern Bengal Railway, and Major Sergeant, who has been acting for him, goes as Officiating Consulting Engineer for Railways in Bombay in the place of Major Firebrace, going on furlough.

THE Governor-General in Council has desired Sir Edward Buck, Kt., to communicate to Mr. T. N. Mukharji and other officers connected with the late Colonial and Indian Exhibition, the thanks of the Government of India for the aid rendered by them in connection with that Exhibition.

IN view of the pushing on of the work of the Periyar Irrigation Project, Madura district, during the coming hot season, a further allotment of Rs. 1,60,000—in addition to the 5 lakhs already sanctioned for expenditure during the coming official year—has just been made by the Government of India.

MR. J. A. JONES, M.I.C.E., Vice-President of the Municipality, who has labored with great zeal for the City for several years, and identified his name chiefly with the great improvement of the Water-Supply and Drainage system of Madras, has been elected a Fellow of the University.

THE following Royal Engineer officers are appointed to the Military Works Department, and posted to the commands named:—Lieutenants V. Murray and Burn to Meerut; J. Murray to the Presidency and Oudh Command; Partridge to Rawal Pindi, and Kingscote to the Sirhind and Lahore Command.

A LONDON correspondent writes:—"I hear that the Barrakur Iron Works are likely to be taken off the hands of the Government by a private company. At any rate, negotiations of a promising character have been undertaken, and a gentleman has been sent out to India to make enquiries in the interests of the proposed purchasers."

WE are glad to learn that an effort is being made by the Government to find employment elsewhere for those of the establishment of the Director-General of Railways who will be thrown out of service by the amalgamation with the Secretariat. Some of the Local Governments and Railway authorities have been informed that the services of the men are available for employment.

COPIES have been distributed to all Commissioners and Deputy Commissioners in the Punjab, of the Circular from the Government of India, Public Works Department, requesting that measures may be taken to prevent any object of archaeological or historical interest being excavated or otherwise disturbed without the previous inspection and consent of the Archaeological Survey Department.

THE Bombay Municipal Corporation, at their meeting yesterday, sanctioned the construction of several new works out of the available balance of a lakh of rupees granted by them on the 1st instant. The works were sanctioned to be paid for out of the current revenue, an item of Rs. 51,475, for the cost of providing water mains in certain streets of the City, being debited to loan account.

A RATHER serious explosion occurred on the 12th instant at the Government Gunpowder Factory, at Ishapore, near Calcutta. The explosion took place about 7 A.M., when starting one of the incorporating mills, in one of the mill rooms. It set fire to the roof of the building, but fortunately no lives were lost, and little or no damage has been done to the machinery. The cause of the explosion is not known, but a board of experienced officers has been appointed to investigate and report upon the matter.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

AN INQUIRY.

SIR,—Could any of your numerous readers inform me if a four years' apprenticeship in a first-class workshop, and one on board a steamer, entitles one to a "legal" five years' certificate.
STUDENT.

ANOTHER SUPERSESSION?

SIR,—I see in your issue of the 10th instant under the head of P. W. D. "Gup" that you couple Mr. Joll with Major MacArthur as being in the running for the S. W. Circle, Bengal, when a vacancy occurs.

I believe you are correct as to the "Gup," but it will be a swindle, for a C. E. of senior service in every grade to be passed over by a junior R. E. whose only claim to the appointment lies in the initials affixed to his name, and to the fact of his having officiated on two or three occasions, as a temporary measure, at a time when it would have been inexpedient to have removed the former from what is termed "Foreign Service," and when he should have derived no pecuniary benefit from the change.

The position has been altered since the introduction of the L. S. G. Act, and Mr. Joll is no longer on "Foreign Service." But I should be very sorry to see another battle fought on the subject of R. E.'s and C. E.'s, for beyond that difference Major MacArthur ought not to be in the running at all.

FAIR PLAY.

A MORAL AND A TALE.

SIR,—The last Report of the Directors of the Madras Railway, deals with an item the immediate bearing of which to the profession in this country is not without a lesson, although the novelty of it is worn out by constant repetition. On the Calicut extension of this line is the Feroke bridge on the B-y-pore river. The depth of the stream near its centre is 40 feet, the length of the girder is 130 feet, and its weight 50 tons. The accident to it from want of nerve of the workmen is thus described by the Chairman:—Towards its foremost end the girder is supported by a pontoon which floats it from the bank to the pier for which it is intended. At the near end it is placed on what is called a lorry, which rests on four or five pieces of pile, each five inches in diameter, which form rollers for moving it along the rail. Now the movement of the rollers must be regulated exactly by the progress of the pontoon. At each end of each roller, a native workman is stationed with a wedge which he keeps moving in front of the roller as it goes along. They have particular orders, constantly repeated, to allow the rollers to move not more than two or three inches at a time, and then to insert the wedge. For a moment the eye of the Engineer or Overseer is off them, they allow the girder to get a slight run, and without putting in the wedges they all get frightened and run away, some of them carrying the wedges off with them in their hands. The result can be easily imagined, and it is described by the Chief Engineer, who writes:—"Owing to the forward movement (on rollers) of the girder having become slightly greater than the rate of progress of the pontoon, the latter tilted over, the water rushed into the barges, and the vessels sank." Now, though the arrangements of the Engineer were in every sense sound and practical, an accident happens, owing entirely to a foolish panic of the native workmen, who desert their posts at a time when their action is specially required. Fortunately the girder in this instance was in no way permanently injured—having been made good in a fortnight's time, and is now in its place; but the case well exemplifies one of the many difficulties connected with Indian Engineering.

VERITAS.

DEODAR VERSUS STEEL SLEEPERS.

SIR,—The experiences related by "T. H. E." in your issue of the 10th, are indeed unique, but if he wishes men of experience to take his figures as correct, he should give more details, i.e., class of steel sleepers used, quantity and description of ballast, &c. Few will believe that an engine and 30 vehicles ("accident No. III.") were derailed, and ran over deodar sleepers for five rail lengths, without doing more damage than he reports. In a case which came under my notice a few months ago, where the centre wagon of a train was derailed, and dragged nearly one quarter of a mile, every deodar and fir sleeper was damaged, "many being cut clean in two," and had to be taken out, besides a large number of chairs and fish-bolts being broken; the road in this case had been opened out for repairs, and of course the sleepers were bare.

Accidents II. and I. would appear to have happened on an unballasted portion of the line; if so, this would account for the heavy damage done.

Last month a spare tender was derailed at a crossing, and dragged for 200 feet over a line laid with D. and O. sleepers, without doing any damage; the road in this case being fully ballasted.

I think "F. R. U." is wrong, in stating that steel sleepers, weighing 125lbs. each, are strong enough for the 5' 6" gauge. Even with moderate traffic, nothing under 160lbs. will answer; in fact, some weighing 145lbs., "exclusive of chairs," were worn out in one year on a 4' 8½" gauge line in England some time ago.

The great objections to steel sleepers are:

1st.—They cannot be made in the country.

2nd.—As scrap, they have little, if any, value.

3rd.—They are difficult to pack.

Good pattern cast iron sleepers have none of these defects.

P. W. INSPECTOR.

March 19, 1888.

ROLLED IRON BEAMS.

SIR,—In reply to the request made in INDIAN ENGINEERING, March 10th, for "Tables for Rolled Iron Beams" calculated from formula in which the moment of inertia is considered, I enclose a copy of a diagram which I have had in use for some time, which may be found useful to others.

The diagram is especially framed for use for determining the best size of rolled girders for flat roofs, and for bridges of small span. Only those girders are included which are readily obtainable in the market, and which are best adapted in ordinary use. In choosing a rolled girder for a roof, the depth should usually be ¼th of the span, and for a bridge ⅓th. It is not desirable to use girders of which the breadth is less than ⅔ths of the depth, unless cross-bracing and strutting is made.

The diagram is framed from the formula

$$W = \frac{7.5 \times t \times I}{12 L \times (d-v)}$$

Where $(d-v) = \frac{d}{2}$ in symmetrical rolled girders.

t = safe strain = 10,080lbs.

I = moment of inertia.

W = total load in lbs. on the girder.

Therefore safe load per running foot.

$$X = \frac{7.5 \times 10,080 \times I}{12 \times L^2 \times \frac{d}{2}} = \frac{12,600 \times I}{L^2 \times d}$$

Where L = span in feet

d = depth of girder in inches.

For the value 7.5 see Rankine, *Civil Engineering*, pages 256—265.

The safe load per running foot for old double-headed rails, 60lbs. to the yard, is also shown in the diagram.

The value of I for the several girders is as follows:—

				I.
Double-headed Rails	...	...	...	16
Girders 6½ × 3½	...	...	...	29
7 × 3½	...	...	...	45
8 × 4	...	...	...	70
9 × 4	...	...	...	90
9½ × 4½	...	...	...	130
10 × 4½	...	...	...	154
10 × 5	...	...	...	175
12 × 5	...	...	...	310
14 × 5½	...	...	...	468
14 × 6	...	...	...	530

Example.—Load per running foot = 540lbs.

Span = 20 feet.

Use 10" × 5" girder.

J. E. HILTON.

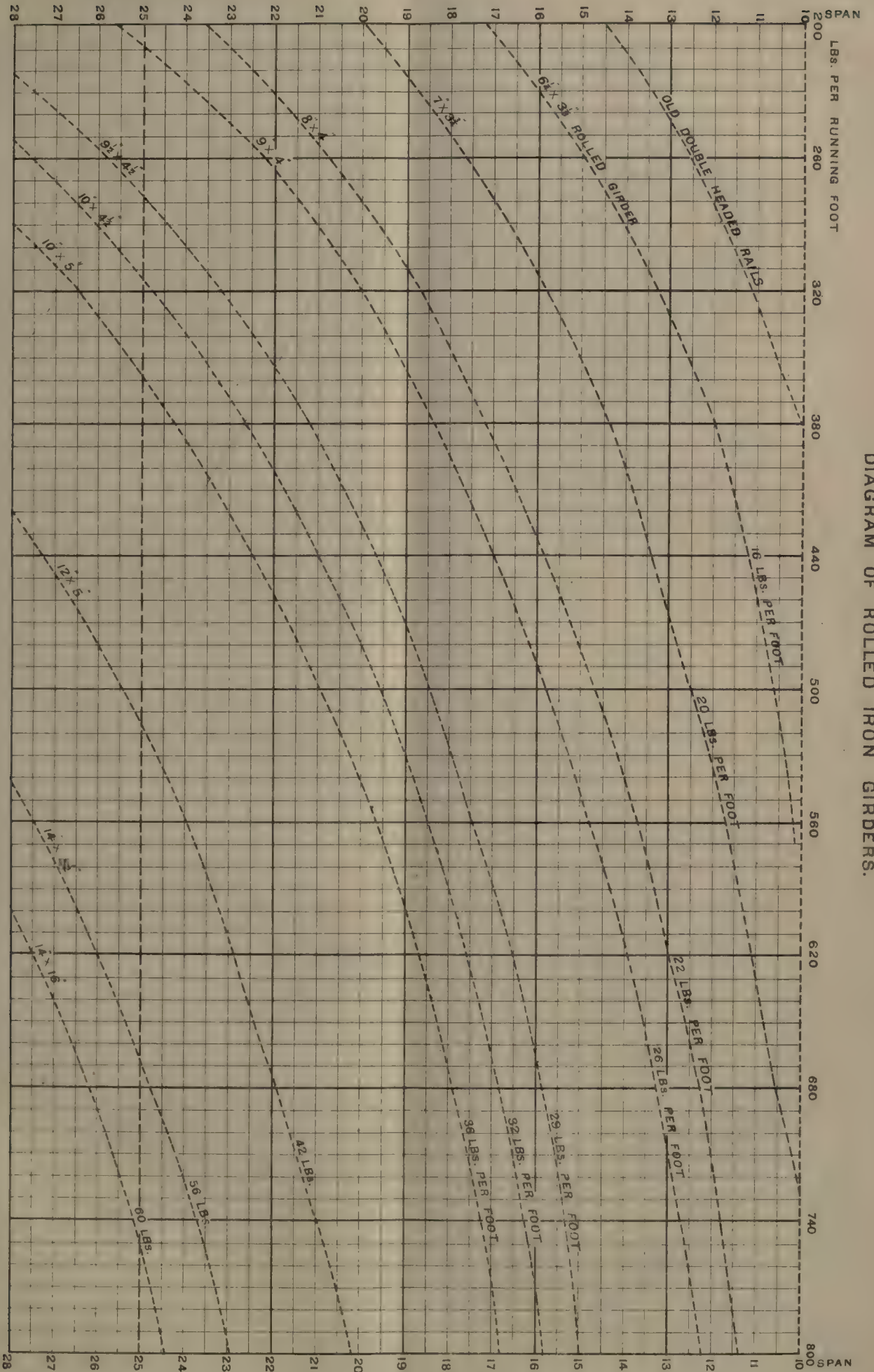
LAHORE; March 13, 1888.

MARRYATT'S SPECIFICATIONS.

SIR,—In reply to my letter, Mr. Bligh writes that the "diagrams of iron roof framing are not copied from Timmins' book, as a reference to the two works will shew, and calculations are made for tile roofs and not slate." I think Mr. Bligh has not compared the diagrams and dimensions of the two works, if he had, he would not have made an inaccurate statement, as on comparing the two works I find the pitch of the roof trusses, the pitch of main ties, the distance apart of the principals, the weight of principals and all the dimensions of the principals are exactly the same as given in Mr. Timmins' book. Will Mr. Bligh kindly point me out where the variation is? As to the covering, it appears to me, that the compiler of the specification has qualified the wording to serve his object, and writes that the trusses can be covered with any ordinary materials not exceeding 15 cwt. per square, while Mr. Timmins distinctly states, that the trusses are designed for slate covering. Will Mr. Bligh oblige me by shewing where the word tile is to be found in the works mentioned?

Mr. Bligh writes: "The method used by Mr. Timmins is

DIAGRAM OF ROLLED IRON GIRDERS.



J. F. HILTON,
 Mem Inst C E

not old and inaccurate, but the new graphical method. What does our critic mean by old and inaccurate method, probably he does not know himself? I am grieved to say that Mr. Bligh in finding fault with me has betrayed ignorance. He ought to have known as an Engineer, that an accurate result cannot be obtained by taking the wind pressure as vertically distributed, because the wind is not blowing vertically on both sides of a roof at one time, and if the stresses are found in trusses on such supposition the result is not correct, and old, because it is the old practice of taking the wind pressure as an uniformly distributed vertical load, which was universally accepted under the influence of Mr. Tredgold; but at that time little was known about wind pressure. Since the experiments of Hutton, and the theory of the pressure of the wind on roofs expounded by Professor Unwin, it is universally accepted and taken up by the profession and others, that the wind pressure should be taken as normal. Messrs. Dubois, Clark, Green, &c., have also taken up Professor Unwin's exposition, and have found out in their graphic statics the maximum stresses in roof trusses by drawing two separate diagrams—one for vertical load and another for normal pressure—and not by drawing one diagram as used by Mr. Timmins.

Mr. Bligh has attributed to me ignorance in not knowing graphic statics. Graphic statics perhaps is new to him, but it is old to me. If Mr. Bligh will take the trouble to read my letters published in *The Engineer*, dated 14th March and 14th November 1884, he will find in the later number the correct method adopted to come to an accurate result.

Mr. Bligh makes a sweeping remark that "the details given in both books are not defective and objectionable" as the examples of these kinds may be seen in Europe, and if the lines of actions do not meet it makes no matter. What a sensible remark from an Executive Engineer! This goes to prove that as examples of these old and defective kinds of details are to be seen in Europe the Engineers should adopt them blindly without improving them in a scientific manner. He is not an Engineer who does not design a structure with the latest improvements in Engineering science. He belongs to the *mistry's* class, who always execute works according to existing examples without understanding the principles and their conditions, and when questioning his authority, his ready answer is, that he has built the structure according to the existing one built by such and such Engineer and it is quite safe.

DORABJEE B. RABADINA.

BOMBAY; March 16, 1888.

Literary Notices.

TACHEOMETRY OR RAPID SURVEYING. By Bennett Hooper Brough, Instructor in Mine Surveying at the Royal School of Mines.

In this pamphlet—a reprint of a paper read at the Institution of Civil Engineers—the author states that methods of surveying in which distances are measured by the chain are now giving place to a method called 'Tacheometry,' in which the measurement is made indirectly by means of a telescope.

The method consists in obtaining by means of a single observation the elements determining the position of every point visible and accessible from a given station.

The instruments required are a 'Tacheometer' and a graduated staff. The tacheometer may be either of two kinds. In the first the length of the staff is fixed and the subtended angle varies; and in the second the subtended angle is constant, and consequently the length of staff intercepted varies.

In the first class of instrument a micrometer wire is used to intersect two particular graduations on the staff, and the distance corresponding to any number of divisions of the micrometer head is taken from tables constructed for each instrument. This is the principle of Eckhold's Omnimeter used for Railway Surveys in America and occasionally in the Revenue Survey in India.

The simplest form of the second class of instruments consists of a tube with three horizontal wires stretched across it. The constant angle is that subtended by the extreme wires at the eye, and the distance of the staff is of course proportional to the length intercepted by these wires. In most cases the distance of the staff from the observer necessitates the use of a telescope and with its introduction this proportionality is destroyed. In 1823 Porro, a Piedmontese officer, afterwards Professor at Milan, devised a remedy for this defect. He introduced between the object-glass and the eye-piece, a third lens by means of which the rays proceeding from the wires to the staff were made to pass through the centre of the transverse axis of the telescope, that is a point directly above the station. The effect of this was

to make the rays determined by the wires start from this point at a constant angle and the distance of the staff from the centre of the telescope, i.e., the station was directly proportional to the length of the staff intercepted by the wires.

This principle is now adopted in all Tacheometers, and each instrument is provided with a horizontal and a vertical circle for determining azimuths and heights. Of the instruments now manufactured those by Troughton and Simms are considered the best, while the Wagner Fennel Tacheometer has the advantage that the distances and heights can be read directly from scales on the instrument, but unfortunately the instrument is thereby rendered too complicated for ordinary service.

As regards Tacheometry, the author remarks that "besides being well adapted for topographical surveys and for preliminary surveys of railways the system has been advantageously used for preliminary surveys for canals, dams, reservoirs and aqueducts. It has also been found the most suitable method for surveys of ditches and pipe-lines in mining districts and elsewhere, as well as for surveys for bridge sites, bridge foundations and all river and harbour work where chaining is difficult. In mining and geological surveys, too, the method has been used with considerable success, and might also be advantageously applied to surveys for drainage or irrigation purposes."

The arguments in support of the method are based for the most part on the grounds of expense, but his reasons though no doubt sound in countries where labor is scarce have not the same weight in this country. In many parts of India, as for example large forest tracts, the method would be useless, and as far as topographical surveying is concerned, the plane-table in the hands of a competent observer will probably give work more extended in detail with equal accuracy. Also the method of traverse surveying and contouring, practised to some extent in the survey of India Department and with great success in the late Survey of the Nicobar Islands, in which an ordinary theodolite is used in conjunction with a staff of given length, will in most cases supply the place of the more elaborate Tacheometer or the allied instrument the Subtense Theodolite which has been in use for many years in this country.

On the whole, while admitting that the instruments and the method are extremely useful, we doubt whether they will find much more favor in India than they have done in England, where they are used to a very limited extent.

New Books and Reprints.

CHEMISTRY AND PHYSICS.

- BRANNT (W. T.) Practical Treatise on Animal and Vegetable Fats and Oils Comprising both Fixed and Volatile Oils, their Physical and Chemical Properties and Uses, the Manner of Extracting and Refining Them, and Practical Rules for Testing Them. Edited chiefly from the German of Drs. Schaedler, Askinson, and Brunner. With Additions and Lists of American Patents, &c. Illust. Roy 8vo. Low ... 35/
MARVELS OF Earth, Air and Water: Being a Popular Account of the Forces of Nature, Gravity, the Barometer, Air Pump, and other Curious and Interesting Apparatus. With Numerous Illusts. (Scientific Recreation Series.) Post 8vo. sd., pp. 130. Ward and Lock ... 1/
—of the Elements and the Strange Effects, of their Combination Being a Popular Account of Metals, Bases and Salts, Alchemy, Distillation, Flame and Acids. With many Illusts. (Scientific Recreation Series.) Post 8vo. sd. pp. 182. Ward and Lock ... 1/
—of Heat, Light and Sound: Being a Popular Account of Heat in its various Manifestations, the Thermometer, Specific and Latent Heat, the Eye and Optical Illusions, the Telescope and Microscope, the Ear and Hearing, the Phonograph and Micrograph, Surging Flames, &c. (Scientific Recreation Series.) Post 8vo. sd., pp. 208. Ward and Lock ... 1/
—of Invention and Scientific Puzzles: Being a Popular Account of many Useful and Interesting Inventions and Discoveries. With many Illusts. (Scientific Recreation Series.) Post 8vo. sd., pp. 114. Ward and Lock ... 1/
MEYER (L.) Modern Theories of Chemistry, Translated from the German by P. Phillips Bedson and W. Carleton Williams, 8vo. pp. 628 Longmans ... 18/
STIRLING (W.) Outlines of Practical Physiology: Being a Manual for the Physiological Laboratory, including Chemical and Experimental Physiology, with Reference to Practical Medicine. With 142 Illusts. Post 8vo, pp. 320. Griffin ... 8/6
WURTZ (A.) Elements of Modern Chemistry. 3rd American ed, Edit. by W. H. Greene. Post 8vo, pp. 756. Lippincott ... 10/6

General Articles.

NAGPUR WATER-WORKS. THE WORKING OF THE SCHEME.

II.

Preface.

FULL information on every detail of the "Construction" of the Nagpur Water-Works was published in the issue of INDIAN ENGINEERING of the 10th March, 1888, and it is not proposed to say anything further on this subject.

This paper merely deals with the working of the Scheme, and reviews the records of the past 15 years; the subject appears to be one from which much may be learnt, and on which information is rarely forthcoming with any degree of accuracy.

Rainfall.

The rainfall records now extend over 33 years, and there is but little to add to the remarks made in the previous report when reviewing the figures in 1882.

The average then considered was for 25 years, and was 38'65" for the monsoon months; taking now the average for 30 years, it amounts during the same period to 39'80".

Diagram No. 1, Plate II, gives the monsoon rainfall for each year since 1854, and shews the number of inches above or below the average.

2. Attention was drawn in the previous report to the disproportion between the number of years above the average, and the number of consecutive dry years in 100, to the general averages for each of these as deduced from observations at 13 places in different parts of the world, detailed in a Table of that report.

The differences are still great, but not quite to such a marked degree. The table referred to, was drawn up by Mr. Binnie, and was alluded to at the Institute of Civil Engineers by so good a meteorological authority as Mr. G. J. Symons as "one of the finest, if not the finest, table of its kind that had ever been compiled." It gave the rainfall at different stations all over the world with the variations expressed in terms of the mean annual rainfall as unity.

The following statement shews the most important variations as they now stand:—

	Percentage of years above the average.	Proportionate No. of periods of 3 consecutive dry years in 100.	Greatest No. of consecutive dry years.
Nagpur, 1882 ...	53.0	14.2	3
" 1887 ...	51.5	15.1	3
General average from Binnie's Table	45.8	20.3	5

3. For the 15 years, since the reservoir has been in use, the average rainfall has been 43.5 inches, and in only one case has it fallen below 30 inches.

There has been one period in this interval of 3 consecutive dry years of which the average was 35.10 inches; the remark therefore made in the previous report, that the reservoir has been so far working under favourable conditions, and its capacity for maintaining a good supply for the city during successive years of low rainfall has yet to be proved, still holds good.

4. The number of days over which the rainfall spreads, has a very large range and varies from 12 to 88 days. In the case of the year in which the reservoir did not fill a rainfall of 24.26 inches was spread over 90 days. Omitting the abnormal year of 1873, the averages are as follows:—

Number of days the reservoir takes to fill.	Rainfall to fill the reservoir.	Rise of water level.
37	Inches. 22.34	Feet. 7.46

Thus in an average of a little over a month, and with 22.3 inches of rain, the reservoir is compensated for the consumption from all causes of the preceding 9 or 10 months. The general average rainfall being 39.8 inches, the percentage of this, required for the above purpose, is 56, and an average of 44 per cent. runs to waste.

Quantity Discharged from the Drainage Area.

1. When the reservoir was under construction, a series of experiments were made to arrive at the quantity of water discharged from the drainage area; the results were published in the Proceedings of the Institute in 1874, and when plotted formed a curve, owing to the proportion which is discharged commencing at zero at the beginning of the monsoon and gradually increasing as the rains continue.

The diagram is here reproduced—No. 2, Plate II. The horizontal measurements represent the inches of rainfall; and the vertical ones, the percentages which flowed from the ground into the reservoir.

The conclusions arrived at were, that in an average season's fall of 37.5 inches 38 per cent. may be expected; and in a minimum year of 19.28 inches, about 15.5 per cent.

2. From the records of the daily fall of rain and the register of the heights of the water in the reservoir, a Table has been compiled, and in it are entered—

- The number of inches of rain that filled the reservoir.
- The number of days over which it spread.
- The rise of the water level.

From this data the proportion of flow from the drainage area alone has been worked out and the results have been also Tabulated.

3. The number of days over which the rainfall that filled the reservoir was spread, varies from 12 to 88. In the former case 31 per cent. of a rainfall of 18.34 inches was impounded, and in the latter 13 per cent. of a fall of 34.39 inches.

4. It was found that whilst the average impounded from the drainage area alone is 23.6 per cent. of an average rainfall of 22.4 inches, this quantity sometimes reaches 31 per cent. for 18.3 inches, and sometimes is as low as 13 per cent. for 34.4 inches.

It will be easily inferred from this, that a single year's datum of rainfall and discharge will be of no use; the average is also no proper guide as for the whole season's rainfall; it is not possible to store the excesses of the wet years to supply the deficiencies of the dry years, and as the floods help materially to swell the average, this average cannot be obtained from the reservoir.

5. Under these circumstances, there seems to be no reason why the available discharge from the drainage area should not be treated in accordance with the well-known rule for calculating the available rainfall, viz.—to take the mean of the discharge from the three driest consecutive years.

6. There are three series of 3 consecutive dry years, thus:—

Rainfall. Inches.	Percentage discharged.	No. of days.
(i.) 22.46	24	56
(ii.) 23.80	21	41
(iii) 26.00	18.6	57
Average 24.0	21.3	51

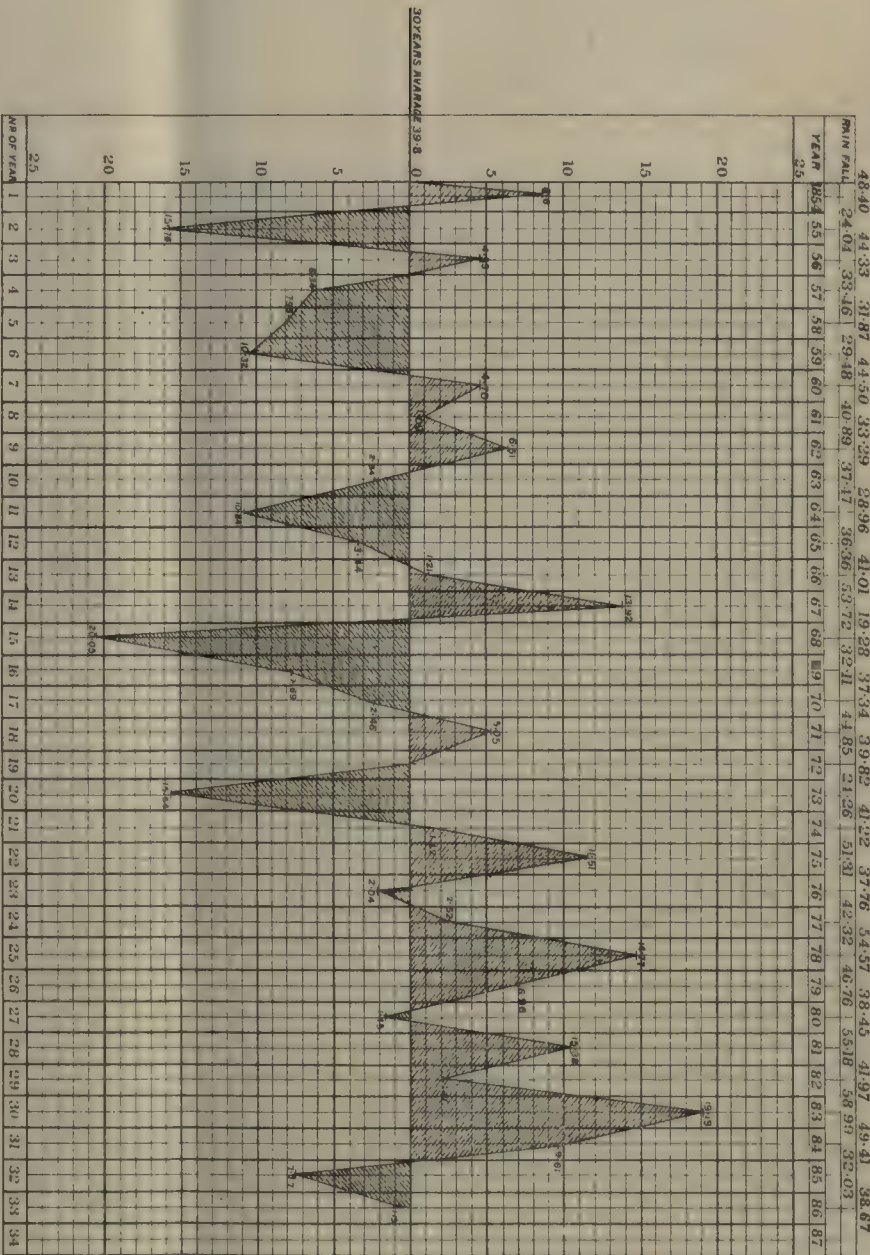
Thus 21.3 per cent may be expected to be discharged from the drainage area alone from 24" rainfall. In the same proportion for 30" 26.6 per cent may be expected and for 40" 35.5 per cent. may be expected.

7. Turning now to the diagram of discharges, and comparing the results thus:—

THE NAGPUR WATER WORKS.

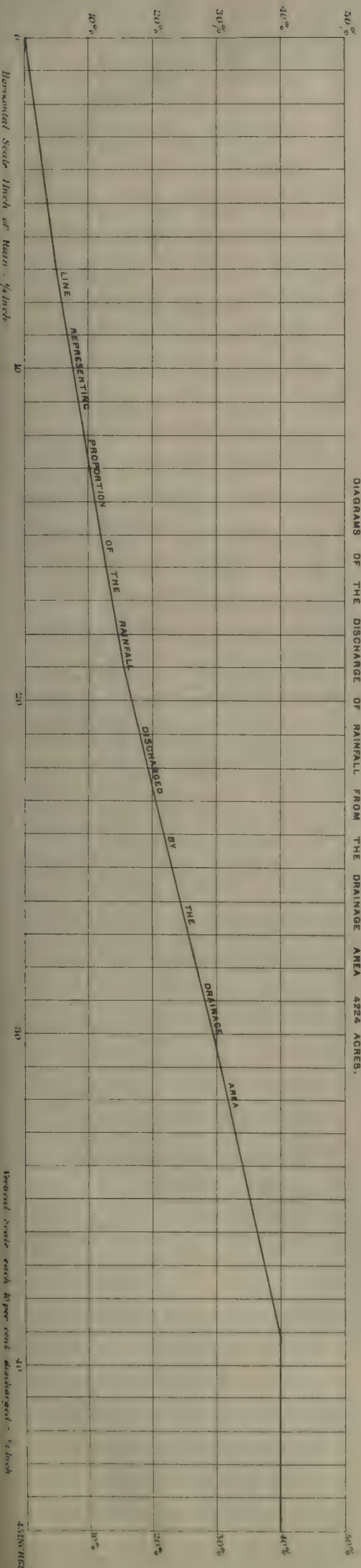
DIAGRAM OF RAINFALL AT AMBAJHERI DURING THE 5 MONSOON MONTHS JUNE TO OCTOBER.

№ 1.



DIAGRAMS OF THE DISCHARGE OF RAINFALL FROM THE DRAINAGE AREA 4224 ACRES.

№ 2.



E. PENNY
Executive Engineer
Nagpur Division.

Rainfall.	Yield from data and proportion.	Yield by diagram.
24	213	21.5
30	266	29.0
40	355	40.0

It is seen that those given by the diagram are the higher, but at the same time it must be remembered that it is a well recognized fact that the larger the rainfall the greater the proportion that will be obtained from the ground, and *vice versa* the the smaller the rainfall the greater the proportion that will be absorbed and evaporated. If then 5 per cent. be added for the 30" rainfall and 8 per cent. to the 40" for increase of yield owing to the soakage of the ground then, for

24"	...	... yield	= 21.3
30"	...	...	= 27.9
40"	...	...	= 38.3

8. These percentages are still below those given by the diagram, but are quite close enough to lead to the conclusion that for all practical purposes of calculation the discharges given by the diagram are sufficiently accurate for this particular drainage area and may be taken as a useful guide for all similar ones.

(To be continued.)

THE MANUFACTURE OF IRON AND STEEL IN INDIA.

III.

THE celebrated "Wootz," the Kutub Pillar at Delhi, the wrought-iron cannons of Assam, the ship anchors from Palamow, the suspension bridge at Saugor (C. I.), the wrought-iron gates at Shoamnath, &c., are worthy specimens of Indian blacksmith art and handicraft, and will remain so for ever.

The introduction of European culture in India, and with it that of large quantities of cheap iron and steel goods of European manufacture, have mostly contributed to the removal of indigenous native iron and steel industry, which, at present, only exists in those more remote parts of India, where European goods are more expensive, labor and vegetable fuel, however, being cheap enough to allow of the existence of native manufacture instead of imported articles.

Iron ore exists in almost every district of India. The most important forms are:—

- 1. Magnetite ore ($\text{Fe}_3 \text{O}_4$), sometimes as titaniferous sand.
- 2. Red iron ore ($\text{Fe}_2 \text{O}_3$) red hematite or specular iron ore.
- 3. Brown iron ore ($2 \text{Fe}_2 \text{O}_3, 3 \text{HO}$), brown hematite, limonite and laterite.
- 4. Carbonate of iron (Fe O, CO_2), and clayband ironstone.

The most important deposits of iron ore in India are the magnetites and specular iron ores near Chanda in the Central Provinces; the limonites near Kutni, also in the Central Provinces; and the brown iron ores at Barakur, in Bengal.

All these ores exist in enormous quantities on or near the surface of the ground. Sufficient fuel and flux for their reduction, as well as railways, are close enough to the ores to justify their conversion into iron or steel on European principles.

Taking further into consideration that the import of iron and steel goods into India amount to about 200 lakhs of rupees per year, together with cheap native labor, it seems rather strange that iron industry in this country has not had more attention than has hitherto been bestowed on it.

The following is a short description of the more important deposits of iron ore in India.

The iron ores near Chanda are distinguished by their purity and richness.

Specular iron ore exists at Lohara, longitude $79^\circ 47\frac{1}{2}'$ E., latitude $19^\circ 22'$ N. and magnetite ore at Peepulgaon, longitude $79^\circ 34'$ E., latitude $20^\circ 23'$ N. *

The following is the chemical composition of these iron ores:—

	Lohara ores.	Peepulgaon ores.
Metallic iron	69.00 per cent.	69.00 per cent.
Oxygen in combination ...	29.57 "	26.29 "
Manganese quioxide ...	0.10 "	...
Silica	0.84 "	4.21 per cent.
Alumina	0.43 "	...
Lime	0.05 "	0.50 per cent.
Sulphur	0.01 "	...

Each of these deposits forms a continuous accumulation of compact iron ore, constituting a hillock, and is prolonged deep under the general level of the country. The ores are found in such quantities in these places that an iron-work, producing 80 tons of rails daily, might be fed from each deposit for about 100 years without resorting to the deeper lying ores at greater expense. Besides these two deposits, there are other places in the Chanda district where iron ore is found, namely, Lankachen, Ratnapur, Dewalgaon, Ogulpet, Metapur, Gunjwahi, Joonona, Kandeshwa and others; the ores in these places, however, being either of a poorer quality and containing more impurities, or not being so advantageously situated as those of Lohara and Peepulgaon, deserve, at least for the present, no consideration.

The iron ores of Lohara have in their few impurities all the component parts necessary for the formation of such blast-furnace slag which has the proper chemical composition in regard to the ash contents of the fuel, so that 3 per cent. only of flux will be required for smelting these ores in the blast-furnace by means of charcoal.

The proportion of the pig-iron to the slag in the blast-furnace should not exceed that of 5:1. The reason of this is that the pig-iron, which accumulates in the lowest part of the blast furnace, requires to be protected from the decarbonising effect of the blast streaming out of the tuyeres. This protection is offered by a sufficiently thick layer of slag, which, being specifically lighter, floats on the surface of the pig-iron bath, keeping off every injurious action of the air hovering over it. As a rule, the quantity of slags is twice and three times as large as that of the pig-iron. In the smelting of the Lohara ores, the decidedly rare case presents itself of the ores being *too pure*—the blast-furnace slags, consisting of the impurities of the ores, the ashes of the fuel and of the flux, representing 16 per cent. only of the quantity of pig-iron. To complete, therefore, the deficiency of 4 per cent., the ores of Lohara require an addition of about 12 per cent. of an inferior ore, which is to be found in the neighbourhood of Lohara.

For the reduction of these iron ores in the blast-furnaces, the forests of the Chanda district offer sufficient vegetable fuel, and at prices sufficiently cheap for the production of iron and steel of the best quality, in large quantities, and at competition prices.

The forests of the Chanda district cover an area of 3,325 square miles, of which, however, at present, owing to considerations of carriage, only that part should be exploited as fuel for the reduction of the ores which lies within a circumference of about 20 miles radius round the place, which has been chosen as the most suitable for the erection of an iron-work.

This part of the forest covers about 520 square miles, capable of yielding 16,000 tons of dry wood per square mile in its present condition.

*A map will be issued with the next article showing these and other "Mineral Localities."—ED., I. E.

According to information from the Conservator of Forests, Central Provinces, from this quantity must be deducted about 30 per cent. for reserved trees, which, owing to the valuable quality of their wood, or owing to other reasons, may not be made into charcoal, so that about 11,000 tons of wood per square mile may safely be counted upon as available for reducing to charcoal.

(To be continued.)

MANDALAY TOWN EMBANKMENT.

By JAMES DONNAN, ASSISTANT ENGINEER, P. W. D.

II.

IN August 1886 the embankment was breached at the point marked (2) on the plan. The P. W. D. were at work on the leak trying to stop it, but all hopes of saving the town were given up between 5 to 6 o'clock in the evening, when one of the Elephants engaged in trampling down the new earth thrown up, suddenly fell, and about 30 feet length of the embankment collapsed. The breach rapidly widened and deepened, and a torrent of water came rushing in. I was at the time at the shore, having charge of the embankment from C road to Amarapura. News was brought me at about 7-30 that the embankment had burst and a large volume of water was rushing along the Thengaya creek. Calling up some gangs of workmen who were engaged on a leak at the point marked (4), I tried to get to the scene of the breach, but was stopped by the rush of the water when I had reached C road. I then saw it was utterly hopeless and returned to the shore cantonment, giving warning to the Transport and the Military there to move everything up on to the top of the embankment as I knew there would be about 8 feet depth of water inside the embankment in the cantonment. About 10 o'clock in the evening there was a foot of water in the Cantonments and the idea of getting boats over the embankment was entertained. The Officer Commanding the 1st Madras Pioneers, who were on the shore, kindly mustered all his men. Captain Black and other officers of the Government vessels at the shore were very energetic, and the Commanders of the Irrawaddy Flotilla Company's steamers also lent boats and men. In a very short time there were 10 boats across the bund, manned and in charge of Europeans who volunteered, and started to save life. The portion of the town lying between B and A road is thickly populated and is in low ground. Being cut off on all sides by the Thengaya creek and the Shwetachoung it was expected they would be the greatest sufferers. It was dangerous and ticklish work crossing the Thengaya creek in the boats, but there was happily no accident to the boats and it was 3 or 4 in the morning before the work was stopped. By that time the water had risen some 5 feet and the current had slackened considerably. The water continued to rise till about 8-30, next morning; it was then seen the whole of the town lying west of the Shwetachoung was under water; no other portion of the embankment had given way and the top of it was crowded with cattle and people, surrounded by water on both sides. The people had not been able to save anything but articles easily carried, and were without food. Rice was distributed to all who came for it at the Commissariat Stores on the shore, and boats containing bags of rice were sent up and down the embankment to issue to the people.

The sights to be seen on the morning after the flood, were both moving and ludicrous. Families with pigs and pariah dogs were to be seen huddled together on the roofs of their houses; in some cases where the shanties were low, the husband and wife with children in their arms were standing with the water up to their waists. In front of some houses you would see the boys and girls with planks and up-turned chatties swimming about in great glee; a little further on you would come across a Burman who had turned his wooden bed into a raft, and putting his wife and children or an aged parent on the bed, he would be in the water pushing vigorously from behind propelling his burden towards the dry ground

to the eastwards. Then again you would meet a fat old Burman lying flat on a plank face downwards with the legs from below the thigh in the water, his cloth tucked tightly between his legs and exposing his elaborate tattoo marks. As you passed him with a smile he would see the amusing side at once and burst into a hearty roar. Further on you would come upon an old woman sitting on the roof of her house, and lamenting the loss of cooking pots, and the small store of rice and oil which she had bought but yesterday for the week. A present of some rice and small coin would be accepted with a smile, but on asking her, if she would like a lift in your boat to the dry land. Oh! no, her son and daughter-in-law had started early in the morning on two planks to do the bazar, and she had been left in charge of the house and cooking! Rather tickled at the idea of any one remaining in charge of a house with only about 18 inches of its roof above water, I pushed on and continued my peregrinations. There were plenty of dead dogs and pigs lying about, but I only saw 5 corpses of human beings in all my different journeys, and I was constantly about the place. After a few days when several boats and canoes had found their way inside the embankment it assumed quite a lively appearance, with races going on amongst the young lads.

I am firmly convinced that the number of people drowned was wonderfully small, not more than 20 all told, and I attributed this to the fact, that the breach having occurred in the bed of the Thengaya creek, the first rush of the torrent was along this nullah. The noise and commotion caused soon gave the alarm, and people were enabled to get off to the high ground. The water on being checked by the south embankment, spread rapidly over the low lying plains south of A road which have very few houses and thus formed a water cushion. The last 5 feet of rise took place very quietly with little current to speak of except just in the bed of the Thengaya creek. In addition to this the Burmans are essentially a water loving race. The children are taken down and bathed in the rivers before they can stand and they learn to paddle about almost before they can walk. Give a Burman a plank and put him in a sheet of water with no rapid current and he will not drown or lose his presence of mind. The fabulous estimates of death framed by special correspondents at the time have no foundation.

The papers attempted to blame the Local Administration and there was the usual out-cry against the long-suffering P. W. D. Of course, I shall be accused of interested motives, but a consideration of the actual circumstances will shew the calamity could not have been prevented. The English did not arrive in Mandalay till the beginning of December, and any repairs or work on the Embankment could not have been done after June, as then the river begins to rise and it is too late. There are, therefore, only six months to account for. In the expedition, the P. W. D. were represented by two subordinates, and it was not till January that any officer was sent up, and then only by one at a time with long intervals between. In March when I arrived at Mandalay, there were only two Executives, one being a temporary fourth grade, and three assistants with a few subordinates in the whole of Upper Burma, and it was impossible for this small staff to do all the urgent work required in the new province. The civil authorities had their hands full in quieting the town, for even some months after my arrival it was unsafe for either Europeans or natives of India to go about alone, and our servants used to do their morning bazar, in bands armed with spears, dahs, lattes, and even master's carving knife did duty as a weapon of defence.

The Royal Engineers who accompanied the expedition were all busily engaged in their legitimate work of accompanying expeditions into the districts, drawing up reconnaissance maps and establishing outposts.

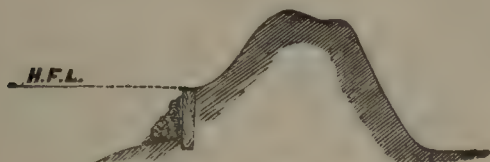
After the water had ceased to rise it was found that the breach having occurred at the northern end, the water inside had risen to the same level as the river at

that point and that at the south end of the Embankment the water inside was about 5 feet higher than that outside. The river had commenced to fall on the day of the breach, and continuing to fall steadily the embankment was opened at two points marked A and B on the plan. It was also opened at the end of C road to facilitate the admission of boats from the river, to move off the people from the bund to the dry ground to the East. The water gradually fell with the river, and towards the end of November the flooded portion began to resume its usual appearance.

In December Mr. Richard, Superintendent of Works, proposed a retired line marked C D and E on the plan, which was agreed upon and all new year's day 1887 was spent by Mr. Richard and myself in examining this new line, sounding the Thengaya Creek and taking cross sections to decide the point of the most favorable crossing. From that day onwards the work progressed rapidly. The work was divided into two sections from A Road northwards being placed under my charge, and southwards being placed under the charges of Mr. Byrne and Mr. Anthony. The southern half of the work consisted in closing the openings at A and B with a strong bund. The bund at B needed to be extra strong and was built 25 feet wide at top with a puddle wall in the centre, and side slope, of 3 to 1 on the river side. This slope being faced with bricks laid flat, and kine grass planted on it and sheet piling along the toe.

The bund at A had no puddle wall in it, but was raised in layers rammed and was faced with bricks on the river slope.

Fig. 2.



The sloping rampart arrangement on the top of the embankment shewn in *fig. 2*, was cut down and thrown on the front slope along its whole length. The corner at No. 5 was strengthened by a large amount of loose rubble packing thrown in front and a second embankment was thrown up inside.

The work in the northern portion consisted in—

(a.) The strengthening of the weak sections from A Road to C Road, and from the point C to the Shwetachoung by increasing the top to 16 feet wide and giving the outer slope $2\frac{1}{2}$ to 1. The portion from A to C Roads was also faced with a stone packing. The weak point at No. 4 was strengthened by making the outer slope 5 to 1, and facing it with stone and sheet piling along the toe of the outer slope. The inner slope towards the Thengaya Creek was also strengthened at this point.

(b.) The retired line C D E, which was made 16 feet wide at top with outer slope $2\frac{1}{2}$ to 1, and inner slope 2 to 1. Its top was raised to 5 feet above high flood level.

(c.) The crossing of the Thengaya Creek, which was made 30 feet wide at the top with side slopes of 3 to 1. The top was raised to 5 feet above flood level. It had a puddle wall 8 feet wide in the centre raised up to flood level, and sheet piling along the toes of both slopes.

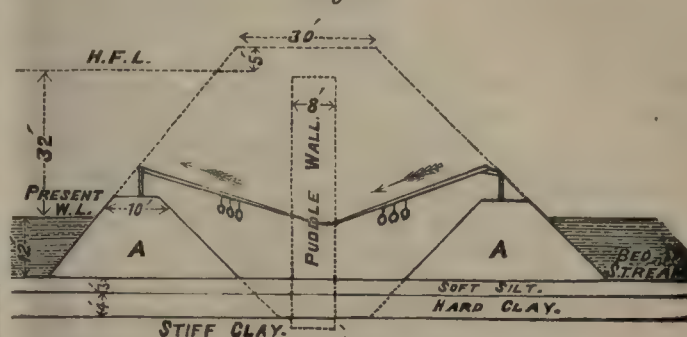
Works (a) and (b) were straightforward and easy; the earth being taken from pits in front and thrown up in layers watered and rammed. It required a lot of constant supervision, to have the watering and ramming properly done as the Burmese were not used to it, and tried to scamp it on every possible occasion.

The embankment across the Thengaya Creek was a very interesting piece of work, and I hope you will not object to a short description of it to close this article.

The creek at this point had 12 feet of water in the deepest part, and was nearly 500 feet wide. The top of the embankment at the lowest point of the bed was 49 feet above it. In the bed there was a strata 3 feet deep

of soft silt and 4 feet below that hard stiff bluish clay was found. The puddle wall was sunk 1 foot into this.

Fig. 3.



The work was commenced by throwing up the two small bunds A, A, right across the creek, the first clod being thrown up on the 2nd January 1887. These bunds were finished in February, and a Gwynne's pump and a 14 H.P. engine, constructed by a French firm, which were found in the palace, were put in good working order, and pumping was continued night and day. Of course, as usual in such cases, the pump was constantly getting out of order. Time was of great importance, for before the regular rises of the river there is always a small rise towards the end of April, of which great fear was entertained. After that the waterfalls and the flood rises commence in June.

On the 6th March pumping was stopped, the water having been taken out, but the silt remained. It was hoped the sun would dry this up, but it was found the small side bunds leaked, and after two days' delay a plank shoring was driven right across, of the same width as the puddle wall with a conduit from the centre to the pump.

The excavation for the puddle wall went on between the sides of the plank shoring, and the pump was put in requisition every two or three hours to take out the water. Several lines of telegraph wire were stretched across, and buckets suspended on small iron wheels with a hook below. Six buckets were fixed on each line, so that as the three buckets filled were being hauled up, the three empty buckets slid down on the other side.

As the excavation went lower the silt between the small bunds gradually dried, and was removed and thrown outside. On the 15th March the excavation of the puddle wall was finished, and filling in began next day, a very good and suitable clay for puddle was found in some old brick-fields about half a mile off, and was carted in for this work.

Want of earth was soon experienced, and the lead from the pits continued to increase daily. It was then found the system of paying by measurements of pits excavated would not answer, as the coolies chucked away a great many basket loads on the road before reaching the place where the earth was required. After some consideration I had small hand carts made up. The carts were of wood and consisted of a box 3 feet long and 1 foot deep. The top was 1 foot 6 inches wide, and the bottom 1 foot wide. This trough was fixed on an axle, the length of the trough being along the axle with two wooden wheels of a broad tire. The wheels being 2 feet in diameter. A couple of shafts with space for one man to get in between them completed the arrangement.

The ordinary wheel-barrow would not have answered, a Burman not being strong enough to manage it. In fact, in Mandalay all the carrying of earth is done chiefly by women and children, the men simply digging and filling the baskets. At first the coolies were very shy of my new arrangement, but I gradually coaxed a few into trying it, and they soon discovered its superiority over the old basket and took to it immensely. The box if properly filled held 7 basket loads, and could be easily managed by two people. One in front between the shafts, and one pushing behind, so that one trip saved $3\frac{1}{2}$ trips to each carrier, and this was of great consequence when the lead was over 600 feet long and increasing daily.

I stationed men, one at the entrance to examine and see if the carts were properly filled, and one at the exit with tickets, one of which was issued for every trip of the box. At the end of the day, payment was made by the number of tickets presented.

The bund now began to rise, but on the 8th April the puddle wall was still 5 feet below the water level outside, and I began to feel anxious about the small rise; therefore, in addition to the hand barrows, bullock carts were also brought into requisition. A cane or bamboo basket was made up 3 feet in diameter and 2 feet high, and fitted on each cart. The basketful was taken as a load, and tickets issued as before. The bullock carts were a greater success than the hand carts, and in a few days I had some 600 carts working. Lamps were provided, and the work went on night and day, and at the end of April when the water rose 6 feet the puddle wall and embankment were 18 inches above this.

The bullock carts also enabled me to do away with the gangs of rammers. In fact, there was no room on the embankment for many people to stand. It was one constant stream of either bullock or hand carts coming in at one end and moving off at the other, and they were constantly getting mixed up one with the other.

The work continued to make good progress, and the puddle wall was finished by the end of May, and the whole embankment early in June. The other works (a) and (b) being finished some time before, only a little dressing and turfing of slopes being required, and these were completed before the flood rise.

Mr. Dickmann, the subordinate in charge of the Thengaya Creek bund, worked very hard and very well, and did not spare himself in the least either night or day.

J. D.

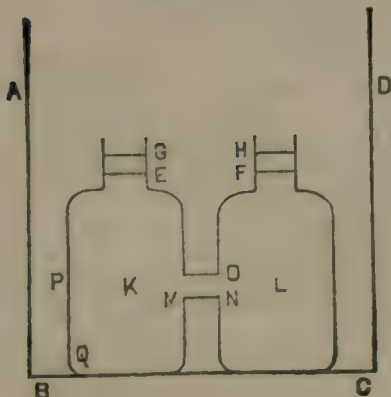
EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.
XXVIII.

Double tiled roofing with semi-cylindrical wheel-tiles.

Items per 100 s. ft.		No. or Quantity.	Rate.	Amount.	Total.
(1)		(2)	(3)	(4)	(5)
<i>Labor.—</i>					
Carpenters	No. ...	4	Variable.	Do.	Do.
Grammies	" ...	3½			
Sundries	... ..	.....	
<i>Materials.—</i>					
Tiles including waste	No.	2,100			
Teak reepers includ-					
ing waste	Rg. ft. ...	210			
French nails	doz. ...	3½			
Sundries	... ..	.....	
Petty Establishment	... ..	.....	

The wheel-tiles average in length 11 inches. The reapers 2" x ½" and are placed 6 inches from centre to centre.

PROPERTIES OF FLUIDS.
BY A. EWANK.
VI.
Fig. 6.



To some of the statements made in the lately preceding parts, it is possible that the reader may be disposed to take exception. Thus it was stated that in our experiments a liquid would be surrounded with pressures, and that over no small area of its surface would the pressure be absolutely zero. But perhaps the reader would consider that in fig. 6 we have a pressure zero on the free surface at G in the bottle K, as on the free surface at H in the bottle L. The pressure there, however, is so far from being zero that it exceeds 2,000lbs. per square foot.

If the vessel is full only up to E, not only is there intense pressure near E, but also in the body of the liquid K, and at the outside particles such as P or Q. In fact, the pressure everywhere is far greater than the mere weight of the liquid K can cause. The enormous pressure over E is due to the weight of the atmosphere. Part of the atmosphere rests as it were on the E surface, and what thus rests is a column of air which may be more than 50 miles in height. The air itself weighs little if we take only one cubic foot of it. But if we take as many cubic feet as are contained in a column whose base is one square foot and whose height is 50 miles or 264,000 linear feet, then the weight of the air may become such a quantity as 2,000lbs.

As an example of another great pressure, let us consider that a hollow ball—such as a foot-ball or a tennis ball—is forcibly sunk in the sea. The depth of the sea is variable, but it is known to be in some parts more than three miles. Suppose therefore that the ball which we call hollow—viz., a ball which has air inside it—is lowered for two miles below the surface of a deep sea. On the sea surface there is also the air pressure, but this though great is relatively small compared with the pressure due to two miles of water.

A cubic foot of water weighs a little over 60lbs. Thus a horizontal square foot area at the depth of two miles has over it a pressure of more than 60,000lbs. independently of the air pressure at the surface. If the ball has a hole in its surface—say at the lowest part of the surface—and its material is so strong as not to be crushed by the water pressures around it, then through this hole water would enter inside. If the inside were what we call a vacuum the water would fill this vacuum. If the inside contains air, a struggle must take place between the inside air and the in-coming water. The result would be that if no air escaped it would have to occupy a much smaller volume than it originally occupied. If there is no hole in the material of the ball, the outside water pressures would crush in the material to some extent.

Now suppose that at this depth of water we had a fish swimming. The body of the fish would have to be sufficiently strong to bear without injury the enormous pressures of the surrounding water.

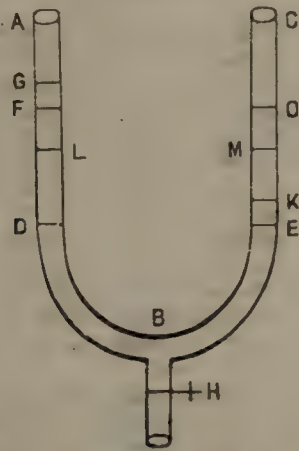
If a man could be placed at that depth—being kept uninjured till he got there—water would enter his ears and his nostrils and would fill most of his lungs. The eye-balls would be flattened or driven inwards and the sight thus probably destroyed.

As a matter of fact, a man does live at the bottom of a certain very deep sea. The sea is the atmosphere. The outside of his body, and likewise the inside, are subject to great pressures. These are not indeed so great as they would be below two miles of water, but they exceed 2,000 lbs. for every square foot on which they act. The tissues of the human body must be constructed to bear this great stress.

If a man could, without injury in the process, have the outside air removed—the whole inner state of his body being preserved meanwhile from any change whatever until the outside air was wholly gone—then the fluids of the body being all at a pressure great enough to resist the formerly acting outside air, would expand when that air was gone. These fluids would tend to force their way out all over his body by a process similar to perspiration, but intensely more violent. Under normal conditions the internal pressures harmonise with the external pressures, and the man is conscious of neither.

The fact that air is capable of exercising at times enormous pressures is seen in the effects called storms, hurricanes, cyclones or typhoons. In all these cases however the air is in rapid motion. But we wish to deal with that pressure which air can and does exert even in a profound calm. To put in evidence this pressure we may make the following experiment.

Fig. 7.



A B C—Fig. 7—is an U-tube of any dimensions. The longer the branches A B and C B the more striking is the experiment. A liquid is to be placed inside. The heavier the liquid, i.e., the greater the weight per cubic inch of liquid, the more striking will be the experiment. Water may be used, but mercury being the heaviest known liquid is much the best for this experiment. The tube need not be uniform in section. One end A should be cut square to the length, and the edge should be smooth. Over this end in the course of the experiment will be firmly placed a finger or the palm of the hand or a circular pad of india-rubber. The diameter of the pad should be slightly larger than that of the section at A; and the pad should be thick enough to be moderately stiff.

We will first describe the experiment in its most perfect form, and afterwards indicate a less complete experiment available for a smaller U-tube. Let the tube be so long that its bent part B is more than 30 inches below the end A. Suppose we take the depth of B below A or C to be 35 inches. The tube below B has an orifice which can be opened or closed at will. First let the orifice H be closed.

Pour in mercury to any height and then open H. The fluid will descend in both branches, keeping the same level. Close H and fill the branches to the top. Now close A firmly by hand or otherwise and again open H. The fluid in the C branch will rapidly and steadily descend. The fluid in the A branch will behave differently. It will descend more slowly.

Close the orifice H before the top of the fluid in the C branch has nearly reached the bend B. Thus the free surface in the C branch rests at K. The level in the A branch will now be at some point G. Open the orifice H very slightly, so that the level in the C branch descends to E, which is still above the bend of the tube. Then the level in the A branch will descend to some part F.

If we now turn our attention to the pad or finger that has been keeping A closed, we shall notice that it adheres firmly to the tube as if it was sucked inwards. There is however nothing within the tube to draw the pad or finger. What it really is influenced by is an outward pressure. This pressure is that of the air outside the tube at A. If we endeavour to remove the pad or finger we feel some resistance. This resistance is caused by the downward atmospheric pressure at A. When we have succeeded in opening the orifice A, the level immediately sinks from F and rises above E, so that the mercury stands at L and M, which are in one horizontal plain.

Let D and E be at the same level. Before A was opened we thus had a column of mercury F D and we might ask how this column is supported.

NOTES FROM HOME.

(From our own Correspondent.)

THE publishers, Messrs. Spon, have just issued an Engineer's Price Book, containing an accumulation of very valuable data as to cost of labor and materials. In these days of close competition, when little margin is left for profit, managers of engineering firms will find in this work a long wanted standard cost book for comparison and guidance. The work is very largely apportioned to shipbuilding and the mass of mechanical engineering connected with the machinery, and the fittings of vessels and of the prices of every description of gearing. A very complete alphabetical list of miscellaneous materials is given, and finally a Directory of Engineers, comprising nearly all the engineering institutions and societies of the country.

A Bill is now before Parliament, the object of which is to secure by registration the protection of the public in their employing engineers, architects and surveyors. It is proposed that there should be a council composed of certain chosen members of the Institution of Civil Engineers, of the Institute of British Architects, of the Surveyors Institute and other societies to grant certificates after examination, and to register the holders of such certificates. Further to make it illegal for any person to practice any of the named professions without being duly authorized by the Registering Council. No doubt there will be considerable opposition to this Bill as the Institution of Civil Engineers has long shewn decided disinclination to examine.

There is a considerable increase in the number of Bills presented to Parliament this year for new undertakings, and also in the amount of capital it is proposed to raise. The total number of Bills is 168 with a proposed capital of over 29 millions, as compared with 143 Bills last year with a capital of 20½ millions. Of the new Bills 102 are for Railways, as compared with 81 last year, 91 in 1886 and 131 in 1885.

The prospectus of the House to House Electric Light Supply Company is now before the public, and bids fair to find much favor. This I believe is the first Company that has been formed to supply householders and others with the electric light at charges which may be considered moderate, when compared with others. The Company propose erecting large central stations in various districts which will be connected by wire to the houses to be lighted by the Company. The Company is to be congratulated upon the unfettered position it finds itself at the commencement, as there are no works of doubtful value to be taken over, or any patent rights to purchase, so that the Company's capital will be entirely applied to the working and extending the business. There is no reason why all householders should not avail themselves of the light as soon as they find one of the Company's stations erected in their district. The scheme has already been put to the test, and from the report of the Brighton Electric Light Company, good results have been found, which argues well for the Company's success on a larger scale. Although the price proposed to be charged for the electricity will at first exceed the price of gas, yet the many advantages should greatly influence the general use of the Company's method of lighting. It is stated that the Company have already a definite demand from householders of upwards of 14,000 incandescent lamps, and no doubt this number will in a short time be largely increased.

The *Engineering and Building Record*, which by-the-by is an additional title adopted by the *Sanitary Engineer* of New York, states that the Standard Oil Company proposes to build an immense pipe line from Lima, Ohio, to Chicago to transport oil for fuel purposes. The right of way is being secured and preparations made for construction. This is the beginning of the proposed 1,000 miles pipe line between New York and Chicago. There has been in use for some years a pipe line from the oil-fields of Western Pennsylvania to New York which will form the eastern connection.

The official statement regarding the income and expenditure of the Manchester Exhibition has been issued this week and shews that the total receipts amounted to £268,290, against which there was a total expenditure of £221,312, leaving a balance of profit of £43,239. This may be subject to some slight modification, but it practically represents the surplus which is left over from the Exhibition, and which was one of the most popular of its kind.

At the concluding sitting of the Associated Chambers of Commerce, held yesterday at the Hotel Metropole, it was moved and carried unanimously "That the levying of dues on coal and wine by the Metropolitan authorities for the

purposes of public works is wrong in principle and unequal in its incidence; and should any Bill be brought into Parliament during the next Session, having as its object the prolongation of the time during which such dues may be collected, petitions be presented to the Houses of Lords and Commons praying that they will not carry the same." In course of the discussion it was pointed out that the city was one square mile in extent, and it collected the tax from an area of 700 square miles. In defence of the tax it was stated that London required £400,000 every year for public improvements, that that money must be found somewhere, and that one had only to look round London to see the good that the tax had done, and that the repeal would do more harm than good.

The last paper read before the Institution of Civil Engineers was on the Economic Use of the Plane-table in Topographical Surveying by Mr. Josiah Pierce. The author directed attention to the wide and economical use of the plane-table in nearly all Government surveys, and to the fact that experience had proved that within certain practical limits plane-tableing was the most rapid, accurate and economical method of executing topographical work. In illustration of the paper, a collection of instruments was exhibited, comprising several varieties of plane-tables, Portuguese alidade, alidade with solar, Porros' tachometer, Colonel Richards' cavalry sketching boards, and others, besides various instruments used in topographical surveying.

MINING IN GREAT BRITAIN.

(From our own Correspondent.)

THE Newbury Vautin process of extracting gold from pyrites is giving great satisfaction in Queensland and Victoria. After being calcined the ore is mixed with water to the consistency of a thin paste, and placed within a revolving cylinder, where it is treated with one per cent. of chloride of lime and one per cent. of sulphuric acid. Air is pumped into the cylinder under a pressure of 60 pounds per square inch. The gold is converted into a soluble chloride by the action of the chlorine gas. The contents of the cylinder are then thrown into a filter (worked by a vacuum pump), and water being freely applied the chloride of gold is carried through in solution. The solution is then run through a bed of charcoal, upon which the gold is deposited in a metallic form and the water run to waste. The charcoal is burnt when freely impregnated with gold.

The use of explosives other than roburite and carbonite for blasting purposes has been forbidden in the mining district of Dortmund. Roburite is the most powerful of the two, but both are said to possess the valuable property of being flameless, and of being incapable of igniting an inflammable mixture of firedamp and air, even when charged with coal dust.

The Lartigue single rail railway is being extensively adopted for military purposes in Russia. It is said that one mile track can be laid down by 30 men in eight hours. Upon the level, one horse can easily draw a load of five tons. It seems strange that the system has not been applied to practical use in connection with mines.

A spring of about two gallons of petroleum per minute has been found at a depth of about 300 feet in a bore-hole near Hartlepool. It is probably situated in the lower part of the new red sandstone and immediately above the upper portion of the magnesians limestone.

An adjacent bore hole nearer to Hartlepool passed through a valuable bed of limestone about 60 feet thick. This deposit is almost pure carbonate of lime, and should prove valuable as a flux for the iron ore which is smelted at the blast furnaces which are in close proximity.

Herr Hilt, Manager of the Wurm Collieries, near Aachen, is applying firedamp as fuel to two steam boilers. The gas is exhausted through a series of pipes placed in the mine, by means of an exhausting engine. He finds that one cubic foot of water is evaporated by the consumption of 115 cubic feet of firedamp.

The curious effect of discharges of static electricity upon smoke, fumes and dust is being taken advantage of for several industrial purposes. It has been successfully applied for the condensation of the fumes from smelting works. It is now proposed to apply it for the condensation of the smoke resulting from the discharge of guns. It seems also to be capable of useful application for the condensation of the

fumes produced during the coking of coal. There is frequently a loss of about 15 per cent. of the carbon which is dissipated as fumes during the process of coking. It would appear possible, therefore, by means of an electrostatic generator, to condense these fumes, and possibly increase the percentage of coke from ordinary coking coals to upwards of 75 per cent. If the desired end was attained by this means, it appears very probable that such "electric" coke would be very dense and most suitable for use in the blast furnace.

The working of high speed steam engines on highways and other roads is making considerable progress on the continent. Unfortunately the state of the highway laws in this country are a great bar to their use. Some years ago, low speed travelling engines were employed in hauling coal in wagons from Warwickshire to the Metropolis, but their use was prohibited through the action of the various local authorities on the route. The rates charged including delivery direct to the consumer were less than those charged for dues alone by the railway companies. The administration of the highway law is very vexatious, as the various local authorities make bye-laws which are not concordant, and what is legal in one area is a legal offence in an adjacent area.

A somewhat remarkable water has been discovered at Wardley Colliery, near Newcastle-upon-Tyne. This water contains a considerable volume of gases dissolved in it. In the early part of 1886, a bore-hole touched a feeder of water which had accumulated in some old workings. The hole was plugged and a tap inserted, so that the water could be drawn off as desired, by means of a pipe to the sump at the bottom of one of the shafts. It was soon noticed that an inflammable gas was being continually given off from this water as it flowed over the cast-iron plates towards the sump.

Two samples of the water were analysed as follow:—

	A.	B.
Volumes of gas contained) in 100 volumes of water)	7.81	10.05
The gas given off had the following composition:—		
Marsh gas	5.20	4.17
Carbonic acid gas	81.14	85.90
Nitrogen	13.29	9.60
Oxygen	...	0.55
	99.63	100.22

This capacity of water for fire-damp may account for its occasional occurrence in unexpected positions.

If a stream of 200 gallons per minute of such water flowed through and between two ventilating doors enclosing, say, between 400 cubic feet of air, the fire-damp given off from the stream would be sufficient to keep the air between the doors constantly in an explosive condition.

RAILWAYS IN CHINA.

(From our own Correspondent.)

THE seven miles of railway built by the Kai-ping Coal Mining Company was taken over by the China Railway Company, at a valuation of taels one hundred thousand. Material was soon brought forward and the line built very economically, it is said, the country being level, and labor both abundant and cheap. The total length of the line is thus thirty miles, or thereabouts. The out-put of the Kai-ping Coal Mines having increased to about 800 tons, some say 1,000 tons, a day, the prospects of the railway were, to say the least, very promising, from the very first; but the good luck of the Company was not confined to carrying coal,—passengers and ordinary merchandise have also been carried, and salt may possibly give the Company a very considerable amount of traffic in future, if it has not already contributed to the increase of the Company's returns. Last spring the newly formed Ministry of Marine was persuaded to memorialise the Throne for permission to extend the coal-hauling railway from Yen-Chuang, or Lu-Tai, *via* Pei-Tang Forts, to the Taku Forts; thence *via* Chun-liang, Ch'eng, to Tientsin, with a view of being able to utilize the railway in times of war for the carriage of troops and military stores to the Forts on the sea coast. The necessary Imperial decree authorizing the extension of the railway was accordingly

issued, and the China Railway Company was also authorized to raise the necessary capital and build the line without delay. The distance, or length of the new line, is about sixty miles, and it was estimated that a capital of one million of taels would suffice to construct the line and procure the necessary increase of rolling stock. Contracts for material were entered into at once and work commenced, but the Company has so far been unable to raise the required one million taels. A *fac-simile* of its scrips was given in the *Shih Pao*, a Tientsin paper, last week, and the shares are said to be of one hundred taels each, and are transferable by registration in the Company's books. Foreigners are not allowed to own any shares, and Chinese having no confidence in the Directors, will not invest.

The floods last summer washed away a good deal of the embankment and retarded the work considerably. Now, however, the fine weather is in favor of the enterprise, but there are no funds to work with.

Six thousand tons of material are said to have been delivered in the neighbourhood of the works by the contractors for the necessary material, but there are now no funds available to carry on the work, and the Directors have thought fit to publish an account of their first year's doings with the first thirty miles, up to last April. The cost *per mile* for the thirty miles and rolling stock appears to have been about Tls. 7,500 *per mile*, but it is now known that a line of equal capacity on the Lartigue system might have been built for three-fifths of the money, that is, for Tls. 4,500 *per mile*, and with the prospects of being very much more economically worked than the old system.

The Managing Directors are thus in a sort of fixtured. The accounts published by them are made to shew a gross receipt of Tls. 30,000 for the first year, and after paying all expenses, the nett earnings are declared to amount to Tls. 13,124, which no doubt looks very fine for the first year, but the shareholders are not satisfied with a mere display of such figures; they want substantial returns on their invested capital in the way of dividends, and are vexed because they cannot get anything. They argue that as the line is said to have made money, the money ought to be there ready for use in the distribution of dividends; whereas the Directors acknowledge that they have no money in hand. I believe myself that there are very few holders of scrips amongst the public, that the China Railway Company is practically a private company, and that the money earned by that Company has been used in its operations in the way of extending its lines to Tientsin. The public having few, if any, shares, cannot of course be entitled to dividends, and *would-be* investors in the Company's new scrips cannot of course find any disinterested persons to prove the assertions of the Directors.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Madras, March 13, 1888.

The following intimation, received from the Secretary of State, is published:—

Mr. A. M. Hayes, Assistant Engineer, 1st grade, Madras. Permitted to return, to duty within period of leave.

The following intimation, received from the Secretary of State, is published:—

Lieutenant-Colonel A. C. Smith, Royal Engineers, Executive Engineer, 1st grade, Madras, Furlough extended to 22 months.

The following transfers are ordered:—

Mr. G. D. Wybrow, Executive Engineer, 1st grade, from the Ganjam Division, to the charge of the Rushikulya Division. To join on 1st April 1888 at the public expense.

Mr. C. A. Smith, Executive Engineer, 4th grade, temporary rank, from the V. Circle, North Arcot Division, to the II. Circle, Nellore Division. To join at the public expense on relief by Mr. C. J. Peters.

Mr. C. A. Smith will assume charge of the Nellore Division on Mr. A. A. G. Malet's departure.

The following posting is ordered:—

Mr. R. Ry. S. Subharayachariyar Avargal, B.C.E., Rai Bahadur Executive Engineer, 3rd grade, sub *pro tem*, to the I. Circle, Ganjam Division. To join on return from leave, with joining time.

Mr. S. Subharayachariyar will assume charge of the new Ganjam Division on 1st April 1888 on the formation of the Rushikulya Division.

The following appointment is made:—

Mr. A. A. G. Malet, Executive Engineer, 4th grade, temporary rank, to be Assistant to Chief Engineer for Irrigation and

Under-Secretary to Government, Public Works Department, Irrigation Branch, with effect from date of joining on Mr. J. P. Davidson's departure on furlough. To join at the public expense.

Bengal, March 14, 1888.

Establishment—Railway.

With reference to Government of India, Public Works Department Notification, of the 22nd February 1888, Mr. F. B. Hebbert, Executive Engineer, 3rd grade, is appointed as Under-Secretary to the Government of Bengal, Public Works Department, Railway Branch. Mr. Hebbert assumed charge of his duties on the afternoon of the 7th March 1888.

Establishment—Irrigation.

Mr. C. A. White, Assistant Engineer, on privilege leave, is transferred from the Arrah to the Eastern Sone Division.

Mr. K. H. Stephen, Executive Engineer, is transferred from the Eastern Sone to the Arrah Division.

Mr. J. P. Coy, Executive Engineer, attached to the Arrah Division, is granted furlough for 10 months, with the usual subsidiary leave, with effect from the 13th of April next, or such subsequent date as he may avail himself of it.

Bombay, March 15, 1888.

Mr. T. Summers, Assistant Engineer, 1st grade, is allowed furlough for twelve months.

Rao Sahib Gopal Rowji Tilak, Executive Engineer, 4th grade, sub. *pro tem*, is appointed to act as Executive Engineer, Ratnagiri.

His Excellency the Governor in Council is pleased to make the following appointments:—

Mr. A. Davidson, Assoc. M. Inst. C.E., to be Executive Engineer, Nasik, *vice* Mr. G. O. W. Dunn, proceeded on furlough.

Mr. A. E. Hight, Assoc. M. Inst. C.E., to act as Executive Engineer for Irrigation, Khandesh.

Rao Sahib Ganesh Krishna Apte, B.A., L.C.E., to act as Executive Engineer, Khandesh, during the absence of Mr. J. Ferguson, on privilege leave, or until further orders.

Punjab, March 15, 1888.

His Honor the Lieutenant-Governor is pleased to sanction the following temporary promotions and reversions in the Amalgamated Engineer Establishment of the General and Irrigation Branches of the Public Works Department, Punjab, with effect from the dates specified against each:—

Rai Kanhaiya Lal Sahib, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 30th October 1887, *vice* Mr. Hicks, reverted from sub *pro tem* 4th grade Executive Engineer.

Rai Kanhaiya Lal Sahib, from Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, (temporary rank,) with effect from 6th November 1887, *vice* Mr. Hicks promoted to sub. *pro tem* 4th grade Executive Engineer.

Rai Kanhaiya Lal Sahib, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 15th November 1887, *vice* Captain Abbott, R.E., returned from furlough.

Rai Kanhaiya Lal Sahib, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 27th November 1887, *vice* Mr. F. E. Rose, proceeded on furlough.

Rai Kanhaiya Lal Sahib, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 12th December 1887, *vice* Mr. Sadler, returned from furlough.

Rai Tulsi Ram Sahib, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 24th December 1887.

Rai Kanhaiya Lal Sahib, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 24th December 1887, *vice* Rai Tulsi Ram Sahib, reverted.

Rai Kanhaiya Lal Sahib, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 7th January 1888, on Mr. Harris' return from furlough.

Mr. F. Harris, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 7th January 1888, on Rai Sahib Kanhaiya Lal's reversion.

Irrigation Branch.

Mr. F. W. Carne, Assistant Engineer, 2nd grade, attached to the Irrigation Branch of the Punjab Public Works Department, passed the Professional Examination laid down in the Public Works Code on the 30th January 1888.

Mr. L. F. Maclean, Executive Engineer, 2nd grade, Lower Sutlej and Chenab Division, Inundation Canals, is allowed furlough to Europe for nine months, from the 1st April 1888, or such subsequent date as he may avail himself of the same.

India, March 17, 1888.

Mr. D. F. Martin, Executive Engineer, 2nd grade, Bengal, is granted special leave for a period of two years under the terms of Public Works Department Notification, dated the 3rd October 1887.

Mr. G. E. Moore, Executive Engineer, 1st grade, sub. *pro tem*, State Railways, on the Establishment under the Government of Bengal, is appointed to officiate as Deputy Consulting Engineer to the Government of India for Railways, Calcutta.

Rai Sahib Auzhore Nath Mookerjee, Assistant Engineer, 1st grade, Bengal, is granted special leave for one year, under the terms of Public Works Department letters, dated 3rd October 1887.

Rai Sahib Russick Lal Roy, Assistant Engineer, 1st grade, State Railways, is granted special leave for two years, under the terms of Public Works Department Notifications, dated 3rd October last.

The services of Mr. A. C. Cregeen, Superintending Engineer, 1st class, State Railways, are placed at the disposal of the Indian Midland Railway Company, with effect from the 5th February 1888, the date of his return from furlough.

Lieutenant-Colonel E. N. Peters, R.E., Executive Engineer, 1st grade, is, on return from furlough, re-posted to the Central Provinces.

Mr. P. L. A. Price, Assistant Engineer, 1st grade, Punjab, is permitted to resign his appointment in the Public Works Department, with effect from the 24th November 1887. This cancels Public Works Department Notification, dated 17th January 1888.

Director-General of Railways.

Mr. V. Rigny, Executive Engineer, 1st grade, is transferred, in the interests of the public service, from the North-Western Railway to the Sind-Pishin State Railway.

Mr. H. S. Guinness, Assistant Engineer, 1st grade, passed, on the 12th of January 1888, the Lower and Departmental Standard Examinations, as prescribed in Public Works Department Code.

Military Works Department.

Lieutenant O. H. Stoehr, R.E., temporary Assistant Engineer, 2nd grade, is appointed to the charge of the current duties of the Office of the Executive Engineer, Sialkot Division, Military Works, with effect from the afternoon of the 18th February 1888, until further orders.

N.-W. P. and Oudh, March 17, 1888.

Buildings and Roads Branch.

Subject to the confirmation of the Government of India, Mr. J. W. Alexander, Executive Engineer, 1st grade, is appointed Superintendent of Works, 2nd Circle, Provincial, vice Colonel F. D. M. Brown, v.c., s.c., proceeding on furlough.

Mr. D. W. Aikman, Assistant Engineer, 2nd grade, is transferred from the Allahabad to the Benares Division, Provincial Works.

Mr. W. G. Bligh, Executive Engineer, 3rd grade, District Engineer, Mirzapur, is transferred from that appointment to the charge of the Jhansi Division, vice Major Bellasis, transferred to the Lucknow Division.

Mr. G. R. Bird, Executive Engineer, 2nd grade, is transferred from the Meerut to the Mirzapur district as District Engineer, vice Mr. Bligh, transferred to the charge of the Jhansi Division.

Bengal, March 21, 1888.

Establishments.

Colonel C. M. Browne, R.E., Officiating Chief Engineer and Secretary to this Government, in the Public Works Department, is granted special leave out of India for six months, under section 61 of the Civil Leave Code, with effect from the 4th April 1888, or from such date as he may be permitted to avail himself of it.

Indian Engineering Patent Register.

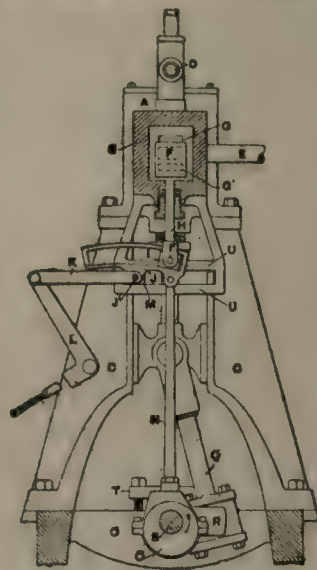
SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 14th March 1888.

- 197 of '87.**—Edward William Parkes, Gentleman, of 3, Salters' Hall Court, in the City of London, England.—For improvements in the production of colored photographic pictures.
- 191 of '87.**—Henry Hamilton Remfry, of 5, Fancy Lane, Calcutta, Solicitor and Patent Agent.—For improvements in the manufacture of frame or horn plates for rolling stock.
- 223 of '87.**—Otto Schwade and Robert Aitken Speirs, Engineers and Rice-millers, residing at Upper Poozoondoung, in the City of Rangoon, British Burma.—For improvements in rice-millings which has for its object the prevention of breakage of grain both during the process of cleaning or pearling and also while the grain is being prepared for the process of cleaning and pearling.
- 243 of '87.**—Edward William Serrell, Junior, Civil Engineer, of New York, United States, temporarily residing in Chabeuil, Department of the Drôme, France.—For process and machinery for reeling silk from the cocoon.
- 244 of '87.**—Edward William Serrell, Junior, Civil Engineer, of New York, United States, temporarily residing in Chabeuil, Department of the Drôme, France.—For improvements in automatic silk reeling machines.
- 18 of '88.**—Sir Henry St. John Halford, Baronet, c.b., of Wistow, Colonel, and William Ellis Metford, of Redland, Bristol, Civil Engineer, both in England.—For improvements in the manufacture of projectiles for fire-arms.

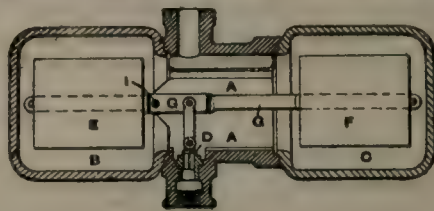
SELECTED BRITISH PATENTS.

VALVE GEAR.—D. Williams, Cardiff, and W. E. Raymond, Yarmouth, Nova Scotia.—The reversing of a steam engine is effected, according to this invention, by the employment of one eccentric only. By referring to the accompanying figure, this arrangement will be seen fitted to a vertical steam engine. The cylinder is indicated by A, and the valve chest by B. The valve F controls the action of the supply ports G and G', and the steam and exhaust pipes are represented at D and E. At



the lower end of the valve spindle H is a jaw, in which is a block I loosely fitting on a pin I'. Upon the upper and lower faces of the block I bears the radius link J, towards one end of which is connected the eccentric rod N. The eccentric O is set at right-angles with the crank R. The radius link J is pivoted at J' to blocks M, which are free to slide in grooves U. A pair of drag links K are connected to the pivot pin J', and are operated by the hand lever L; and the blocks M are thus moved in the grooves U. In the figure the position of parts is such that the shaft S is being driven in the direction of the arrow, and the eccentric rod N and the valve spindle H ascend together as the radius link J oscillates on its pivot J'. In order to reverse the engine the radius link is moved by means of the hand lever until the blocks M are at the opposite ends of the guides U. In this position the eccentric rod moves up and the valve spindle descends, while the shaft S revolves in the reverse direction. The inventors make three claims for the combination of parts represented in the drawings by the letters I J M U K with the other parts of the engine.—No. 15,915 November 19th, 1887.

STEAM PIPES.—J. Kroog, Halle.—This invention relates to the automatic removal of condensed water from steam pipes. The apparatus consists of a valve casing A and two caps B and C, which may be easily removed for cleaning. In this casing the lever G is fixed with the



fulcrum at I. G carries two solid pieces of metal E and F of equal volume but different weight, which are fixed on G in such a manner that the distances from the fulcrum I are inversely proportional to their respective specific gravities. As the water in the casing rises and partly immerses E and F, those two bodies get lighter by the weight of water displaced by them, and as E and F are of equal volume, as pointed out before, they lose an equal amount of weight; but F, acting on a longer lever than E, overbalances E, thereby opening the valve D and allowing the water to flow out.—No. 41,847 May 18th, 1887.

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250 Metre Gauge rails, Vignoles pattern, about 40lbs. to the yard, each rail to be 18 feet long, and suitable for shed posts.

250 Broad Gauge double headed rails, about 66lbs. to the yard, each to be 18 feet long, and suitable for Railway sidings.

Price to be quoted per rail, [and whether steel or iron, should be stated.

The supply to be completed within one month from the date of order.

The lowest or any tender will not necessarily be accepted.

By order,

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PORT ENGINEER'S OFFICE ; } Port Engineer,
Manora, 12th March 1888. } (100) KARACHI.

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Pay and travelling allowances will be as shown below.

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The increase of Rs. 50 over the minimum pay in the case of each of the above 3 officers will be allowed by five equal annual increments of Rs. 10, provided that the officer continues to give satisfaction in the discharge of his duties.

Applications should be made to the undersigned so as to reach him before the 31st March 1888, with the following particulars :—

- (1.) Name.
- (2.) Age.
- (3.) Examinations passed.
- (4.) Present occupation, if any, and previous employments held, if any.
- (5.) Copies of testimonials.
- (6.) Address.

None but those holding the College Certificate need apply.

Successful applicants will have to execute an agreement binding themselves to serve the Madura District Board, in the terms which may be specified by the President.

The applications from unsuccessful candidates will be recorded and no reply will be sent to them.

E. TURNER,

President, District Board,

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DAVID LOGAN,

Chief Engineer, S. I. Railway.

Trichinopoly, March 17, 1886.

(89)

NOTICE.

ALLAHABAD MUNICIPAL BOARD.

WITH reference to the advertisement calling for Plan and Estimate for a Municipal Hall for this City, notice is hereby given that the Board do not wish to tie down competitors to the actual sizes of the rooms therein given as long as their areas are not decreased.

By order,

T. R. EDMONSON.

Secretary, Municipal Board, Allahabad.

ALLAHABAD, 29th February 1888.

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EDITORIAL ANNOUNCEMENT.

Several communications are held over for want of space.

INDIAN ENGINEERING.

SATURDAY, MARCH 31, 1888.

THE RIVAL PLANS FOR THE SHER SHAH BRIDGE.

It is much to be regretted that the old grudge between Royal and Civil Engineers should be imported into any discussion of a purely scientific nature, as has recently been the case with remarks in some of our contemporaries on the rival plans for the proposed bridge over the Chenab at Sher Shah, on the Sind-Sagar Railway.

We are glad to think, however, that the paragraph alluded to, could not have been written by an Engineer, as any member of that profession, who interested himself at all in the matter, would know that the original design was prepared by Mr. Mallet, who is well known as an Engineer of matured experience, while the subsequent proposal was made by Mr. J. R. Bell, who is equally well known in Upper India from his connection with some of the largest bridges.

So far then, as mere authority goes, neither scheme can be said to have the advantage of the other, and we therefore propose to state briefly the chief points of divergence in the two designs for the consideration of our readers, and as the matter is one of purely scientific interest, and one involving large sums, we hope that Government will some day publish the leading papers on the subject, for doubtless Mr. Bell, as his own advocate, would make out a much stronger case than appears on the merely general view that we can give. In this particular case also, as in most Engineering questions, no absolute rule can be laid down, and there may be reasons why Mr. Bell's proposal is peculiarly suited to this crossing, even though it might not generally be the best.

The two designs are, the original by Mr. Mallet for 27 spans of 150' giving 4,050 lin. ft. of bridge, and Mr. Bell's for 9 of 250' giving 2,250, a difference of 1,800 feet in length. Here is a sufficiently startling divergence of opinion between two experts, and it is now our task to point out to our readers the conditions which render such a wide difference of opinion possible.

There are two diametrically opposite ways of bridging the Punjab and similar rivers,—one being to build a long bridge from bank to bank, not of the river, but of the valley in which it meanders; and the other to build a bridge no longer than is necessary to pass the flood, leading the river through it by training works. These of course are the two extremes, with a practicable design somewhere intermediate, and it is this golden mean that is so difficult to decide upon.

Many of our readers are aware, but we should point out clearly for the benefit of those who have not an acquaintance with the Punjab rivers, that such a river never fills its valley so far as actual discharging power is concerned, the main channel being quite narrow and wandering in the valley at all angles from parallel to right across it. Consequently it cannot for an instant be supposed that length of bridge has any-

thing to do with giving more waterway, for however long the bridge, the main channel generally occupies but a few spans at a time. Nor can any bridge be constructed of such a length as to do away with the necessity for training works.

Bearing this in mind, the argument of the advocates for a short bridge is—As any point of your long bridge has to bear as much strain as a bridge of minimum length, and as you must have training works in any case, carry this treatment to its logical conclusion, and do not make your bridge longer than is required to pass the flood, training the river through it.

While the long bridge advocates reply—Your theory may be perfect, but there comes in the practical difficulty of training the river to flow steadily through the same channel for any length of time.

A good practical illustration of this question is given by the old bridge over the Chenab at Wazirabad, which, after being originally built with 64 spans of 142', it is now proposed to reduce by one-half of its length, and which may end in being reduced to one-fourth, and yet the velocity of the main stream will not be increased by the abolition of spans which are only occupied by islands and backwater.

Even from this brief outline of the subject, it is clear how impossible it is to lay down any general rule, and how difficult to decide even in a particular case, what length of bridge to give.

The amount of waterway is really not the principal point, the problem being to decide within what limits of oscillation can the river be induced to confine itself.

Such a very open question explains at once the difference of opinion as to the best length of bridge, between the advocates of the two systems.

But there is also a difference of opinion as to the best length of span, which has no essential connection with the total length of bridge. In this case, Mr. Mallet proposes 150' and Mr. Bell 250'. Of the latter, we only have the Adamwahan Bridge over the Sutlej as an example, while the present Chenab Bridge is the best type of the former. The small spans of the old Sind-Punjab Railway, and of the Ravi and Jhelum, are not likely to be repeated, while the new bridges at Ferozpur and Chuck Nizam are not old enough to give any precise information as to whether their 150' spans are suitable.

In these cases the ordinary rule of equating the cost of a pier to that of the main girders of one span as the most economical arrangement, is modified by other conditions.

We can take the cost of a pier as a fixed quantity almost independent of the span, for the pier that is safe for any span at all, will be quite large enough for a 250' span, the stability against floods being the chief consideration. In fact, if as we suppose the river occupies a certain width only, of what may be called "normal channel," no matter what length of bridge you offer it to wander about in, a small span may require a much deeper pier and much more protection stone to keep it safe, than a larger, simply because it offers more obstruction.

Unless we are mistaken, the old bridge over the Chenab (called the Alexandra) clearly indicates by the quantity of stone yearly devoured by the river, that 140' is too small a span, and if so, it may well be doubted if the extra 10' proposed for the spans of the new bridge, will make any appreciable difference.

We are not, however, aware if it has ever been ascertained, whether the velocity of these rivers is such as to remove the stone from a single well sunk in the stream, or to what extent the consumption of stone in maintenance of the Adamwahan Bridge over the Sutlej with 250' spans, differs from that of those of smaller span.

The problem might be dealt with in the following manner. Find if possible a place with one or two well defined channels. This will be the "normal channel" and its width and velocity at the narrowest place, where erosion is most active, will give an idea of what must be dealt with some day at any point in the bridge. And from this, some idea can be obtained of the afflux likely to be caused by spans of different sizes. Only it must be well remembered that in the bridge, the channel will probably be narrower and velocity greater, than in the natural state, as erosion to the convex of the curve is resisted by the stone protection and converted into the downward scour. It is with reference to this width of stream, and not to the length of the bridge, that we have to arrange our spans, so as not to create an obstruction sufficient to raise the velocity to a point dangerous to the protection stone, on which alone the wells depend, no matter how deep they may be sunk.

In the present case it would appear as if Mr. Mallet had fixed the spans principally in relation to the best proportion for economy alone, while Mr. Bell had considered, and not without apparent reason, to judge from the present Chenab Bridge, those spans as liable to contract the waterway to a dangerous extent.

There are then two issues to decide. Is Mr. Bell's bridge long enough, and are Mr. Mallet's spans large enough; and there we leave the question, not professing to decide who is right.

A NEW RAILWAY PROJECT.

OUR readers will recollect that when the proposed Railway from Umballa to Kalka and thence to Simla was on the *tapis*, all arguments that could be urged in favor of the undertaking were repeated threadbare by one of our contemporaries, but the Government of India respectfully declined to have anything to do with it, with the exception of making the usual concessions to private enterprise. Now, however, when representations have been made to the authorities to permit the construction of a line by two companies, which would bring Delhi, Umballa, and Kalka eight hours closer to Bombay, objection is being raised by that same paper. We think it is the duty of the Press to calmly review the *pros* and *cons* of the case before arriving at an opinion. The proposal has emanated from two sources, *viz.*, Major Bisset the Agent of the B. B. and C. I. Railway Company, and Mr. W. Duff Bruce, in connection with Messrs. Andrew Yule & Co.,

of Calcutta. If carried out it would give a broad gauge line nearly due north from Delhi to Umballa and thence to Kalka. This "would give a broad gauge all the way from Calcutta to Kalka, while a portion of it would supply the means of effecting by a mixed gauge a continuous narrow gauge connection from Kalka to Bombay. It is proposed to connect Jeypore with Rewari by a branch of the Rajputana line, which would then go northward *via* Rohtak to Kurnal, opening up a fertile country. From Kurnal a mixed gauge would take trains to Kalka, broad or narrow, as might be required."

The Punjab Government seems to have set their veto on it for reasons which would not go down with the public, whatever officialdom may think of it, and that too in the face of that Government advocating the construction of a line from Delhi to Kurrachee, that would never have paid its way, notwithstanding the facts and figures quoted by such a great authority as Sir Bradford Leslie. This decision of the Punjab Government which declines to sanction a line that promises to be remunerative simply because the supreme Government would not adopt its recommendation in another case and for valid reasons is tantamount to cutting off the nose to spite the face. "A weak point," says the *Pioneer*, "in the Bombay scheme obviously is that it will involve a break of gauge; whilst it is not quite intelligible why the Company should press for additional traffic on the face of its till lately notorious difficulties in carrying the traffic it already has." With regard to the first objection it may be said that it is purely imaginary, and with regard to the other, as the Company do not want a guarantee, and might be fairly supposed to be the best judge in their own interests, it should be left to those who undertake the risks to decide whether they are justified in accepting it or not. The advisers of the Government of India in the Public Works Department base their opposition on the ground that the line might absorb a portion of the earnings of the North-Western Railway, and thus encroach on its preserves. This can hardly be, as far from interfering with that line, it will serve a portion of the country with which it has nothing to do. The proposed line would greatly benefit the districts to the south of Delhi. Admitting for the sake of argument that it did encroach, why should the interests of Government stand in the way of an enterprise by which the public is the gainer? The history of the world bears testimony to the fact that wherever an exclusive privilege has been granted to an undertaking it has been followed by disastrous results. A death-blow is thus given to healthy competition, and the result is that progress is retarded. When monopoly is encouraged there is no stimulus offered to the exercise of fair and honorable rivalry. On this broad ground alone an enlightened community should take its stand. Vested interests must not be permitted to obstruct progress. Another reason given by our contemporary is that some "weighty authorities contend that it would be a cheaper expedient to secure that (North-Western) line from the inundations to which it is periodically exposed between Umballa and Saharunpore—and which liability has been urged as an argument in favor of the alternative line—

than to face the cost of the competition." What we would ask is, is it necessary that the North-Western line should be threatened with a competition in order to awake the powers that be to a sense of their duty? Is it not incumbent on them to take every precaution to prevent these periodical losses of life, property, and public money, instead of being frightened to it by the prospect of a rival line? As the matter has been referred to the ultimate decision of the Secretary of State for India, we will wait for the result in the hope that the point will be discussed from every point of view, and not from the narrow one of loss to Government.

THE INLAND TRADE OF BENGAL, 1886-87.

THE Secretariat Report on the river-borne traffic of the Lower Provinces of Bengal, the inland trade of Calcutta, and the trade of Chittagong and the Orissa ports, is a bulky volume containing 120 pages of report and 215 pages of closely printed statistics. We will hope that they are of some use to somebody, that the money spent in printing them has not been altogether wasted. Everybody knows now-a-days that statistics are valuable—provided that they are the right ones. But mere array of long lines and columns of figures is not in itself valuable, although some people seem to think that it is—fortunately for Government printers, and petty hucksters who need wrappers for their wares.

In a chapter on canal workings we find the Executive Engineer, Balasore Division, remarking, with reference to the Midnapore and Hidgellee canals:—"The state of these canals in their present condition is eminently unsatisfactory. The boatmen suffered much delay owing to the silted state of the entrances, having to wait in the entrances of the various locks till nearly high tide. It is earnestly hoped that early sanction may be accorded to the estimate for their remodelling."

Of the Orissa Coast Canal the same gentleman writes:—"It is premature to speak of the whole canal from one year's experience of the traffic on one range, but there is every indication of this excellent beginning developing into a prosperous future when the other ranges are complete, the Hidgellee Tidal Canal remodelled, and line of communication open throughout."

Up and down, 9,463 boats were registered during the year under review, against 5,495 in 1885-86.

On the Brahmaputra and Megna rivers the total weight of goods carried by the River Steamer Companies was 9·30 per cent. less than in the preceding year, the trade in European cotton piecegoods shewing the largest decrease. Coal, on the other hand, shewed a considerable increase. The advance in supplies carried from Bengal was small, but exports from Luckimpore in Assam rose from 91,707 maunds in 1885-86 to 2,59,519 maunds in 1886-87. Anent which figures the report says:—"The coal-mines in the Brahmaputra Valley, besides supplying the province of Assam with coal, furnish considerable quantities for export." With the exception of 166 maunds the whole of last year's exports from Bengal went from Calcutta.

Notes and Comments.

LUCKNOW PAPER-MILLS.—Munshi Newul Kishore, G.L.R., the principal shareholder and Director of the present Company, is contemplating to start a new Paper-Mill of his own.

INDIAN RAILWAYS.—The House of Commons passed on 24th March the Bill authorizing the purchase of the Oudh and Rohilkand Railway, and also for developing other Indian Railways.

SECUNDERABAD DRAINAGE PROJECT.—Tenders are invited for carrying out this work, which will be inaugurated with the official year. The probable cost of the work will be about Rs. 75,000.

PERIYAR PROJECT.—A Correspondent writes:—In consequence of the ensuing three feverish months, the Periyar Project works on the hills are stopped, and the whole establishment moved to the plains.

BENGAL P. W. D. SECRETARYSHIP.—The question as to who is to relieve Colonel Brown pending Colonel Luard's arrival, is shelved *pro tem* by the former officer not availing himself of the leave granted him as soon as was expected.

PORTS AND COALING STATIONS.—Mr. Stanhope explains, in his memorandum accompanying the war estimates, that Government propose to expend, during the next three years, three millions in completing the defences of the chief military and mercantile ports and coaling stations, the latter to be completed within a year.

MADRAS GUN-CARRIAGE FACTORY.—Extensions on a large scale are to be made to the Gun-Carriage Factory buildings here, and the Madras Government has purchased a large piece of land whereon will be erected quarters for the accommodation of ninety artificers and four hundred lascars. Provision will also be made for a coal yard.

PELANDORAI ANICUT, SOUTH ARCOT.—This project, which has virtually been completed, includes provision for enlarging the storage works. The project is estimated to irrigate 12,000 acres, and yield a net return of 8.98 per cent. on the estimated outlay. The estimates for this project, sanctioned by the Government of India in June 1884, amount to Rs. 4,05,000.

MUNICIPAL LOANS.—The Governor of Madras urged upon the Government of India during his recent visit to Calcutta that it might be a wise policy to give loans to Municipalities for public purposes; but at present the Government of India do not see their way to allowing a Provincial Government to spend public money upon loans or advances to Municipalities.

BENGAL P. W. D., CALCUTTA, DIVISIONAL CHANGES.—The Lieutenant-Governor is pleased to order the abolition of the Third Calcutta Division with effect from the 1st April next. From that date all building works in Calcutta and Howrah will be distributed between the First and the Second Calcutta Divisions. All miscellaneous payments will be made in the First Calcutta Division.

FLOODS IN THE CAUVERY.—The extraordinary flood that occurred in the Cauvery on the 11th October 1887 caused little damage to the Tanjore delta. It was fortunately unaccompanied by rain in the delta and of short duration, but it is the third highest flood on record, having been exceeded only in 1858 and 1882. The New Cauvery and Vennar regulators lately constructed have saved the Government and the people in the Tanjore delta much loss.

CHANGES IN THE CEYLON P. W. D.—When Mr. Ormsby obtained one year's leave of absence, the post of Financial

Assistant to the Director of Public Works was temporarily filled by Mr. Harvey, who left the other day for England on three months' privilege leave, Mr. Macgregor acting for him. Mr. T. Smith acts for Mr. Deslandes, as Provincial Engineer, W. P.; but what becomes of Mr. Finch nobody seems to know, now that Mr. Wrightson has been promoted to the N.-W. Province.

THE TRUTH ABOUT RAILWAYS IN SIAM.—Thus far, the Siamese Government has not bound itself in any way with regard to railway construction, for the permission accorded to Sir Andrew Clarke to survey a proposed railway line from here up to Chiengmai, a distance of about 400 miles, does not include a promise that his syndicate shall build this particular line when plans and estimates have been drawn out, although Siam has agreed to defray the expense at the rate of £100 a mile.

THE TENT OF THE FUTURE.—This question—not devoid of interest to Engineers—is now exercising the minds of the Quartermaster-General of the Army and his Department; and it may interest many to know the various points under discussion. Briefly these may be divided into two main heads—1st, the *cloth* of which tents should be constructed; and, 2nd, the *pattern* in which last may be included the "*color*," an apparently minor question but of more importance than is generally imagined.

THE MUNICIPAL ENGINEER, CHADARGHAT.—We are sorry to learn that Mr. James Buchanan, A.M.I.C.E., M.R.A.S., of H. H. the Nizam's P. W. D., and Executive Engineer, Chadarghat Municipality, has been compelled through ill-health—malarious fever, caught in some of the fearful slums near the city of Hyderabad—to go home for four months from the 1st April next. We are assured that Mr. Buchanan has had very hard and nasty work during the past year, and requires a change badly.

PALAR ANICUT, NORTH ARCOT.—This project, now practically completed, provides for works required for the completion of the Palar Anicut system and for the full utilisation and regulation of the available supply of water. The project is estimated to irrigate 68,700 acres of first and 34,000 acres of second crop, and to yield a net revenue of Rs. 93,720, or 3.68 per cent. on the estimated outlay. The estimates for this project, sanctioned by the Secretary of State in December 1884, amount to Rs. 18,94,915.

THE MADURA DISTRICT BOARD.—The appointments advertised in our columns are for the Local Fund service. The Assistant Engineer on a salary of Rs. 250 per mensem, rising to Rs. 300, will have charge of the two taluks of Ramnad and Sevaganga comprising the two extensive zemindaries of the same names; the Assistant Engineer on Rs. 200 rising to Rs. 250 will have charge of Dindigul, Periyakulam and Palni taluks; and the Supervisor on Rs. 150 rising to Rs. 200, will have charge of Madura, Tirumangalam and Melur taluks.

MADRAS HARBOR.—The Harbor Trust Board's Engineer gives two estimates for construction during the official year 1888-89—Rs. 12,00,000 if work is carried on at both arms of the harbor, and Rs. 6,00,000 if the south arm only is extended. The Board have embodied the larger sum in their estimate under the head of "Capital Account," as they consider that, whether it is decided to proceed with the north arm, or remove the ruins of the old wall with a view to the construction of a north-east entrance, considerable expenditure will, in either case, be necessary.

THE RANGOON DEFENCES.—The work in connection with the defences of Rangoon is making good progress. Lately General Nairne, Inspector-General of Fortifications, paid Rangoon a short visit for the purpose of inspecting the sites for the different batteries. Five 35-ton guns are to be mounted, but the exact position of each has not yet been decided on: considerable difference of opinion on this point appears to exist between the Defence Committee in London and the Indian Defence Committee. However, the guns are not likely to reach Rangoon for some time to come.

AN ANOMALY.—A Correspondent writes: In Burma Head Constables of Police on salaries of Rs. 65 per month are Gazetted officers, as their appointments appear in the local official *Gazette*, while Public Works Overseers and Sub-Engineers on salaries ranging from Rs. 80 to Rs. 500 do not find their names in the *Gazette*, unless they pass in a native language, have temporary charge of a division, or made Honorary Assistant Engineers. Are Bobbies, who in Burma are youths that have failed for State service, superior to College trained men who have passed into the Public Works Department?

GREAT FIRES IN BURMA.—The season of conflagrations has come round in Burma, and news now comes of three great fires, two at or near Rangoon and one at Mingyan. By the latter the whole native town of Mingyan appears to have been destroyed; while the fire at Rangoon has done damage to town property which is estimated at five lakhs. But this fire was completely eclipsed by a terrible one which occurred at Kemendine outside of Rangoon, on the same day, which entirely destroyed blocks of houses extending over an area of one-and-a-half to two miles in length and some three hundred yards in width.

GERMANS IN JAPAN.—The Japanese papers report a curious dispute between a native railway company and a German firm which contracted to supply rails. The company were informed, when about to conclude the contract, that German rails were not only cheaper, but superior in quality to the English rails. On their arrival, however, the company discovered that the whole supply were of British manufacture, and naturally enough, after the statements of the Germans as to the superiority and cheapness of their products, refused to accept them. The matter has, however, been compromised, but German credit is said to have suffered severely over the matter.

NEW MUNICIPAL OFFICES, BOMBAY.—The Committee appointed to consider and report on the long pending question of the erection of the new Municipal buildings has resolved to recommend the Corporation to vote fifteen lakhs for the purpose. It will be remembered that a proposal to expend seven lakhs on the building of the Municipal Offices was some three years since rejected by a majority of one. Dr. Peterson having asserted that five lakhs would be ample for the buildings and the site. The five lakhs have grown into fifteen; if we wait a little longer they will probably become twenty. The story of the Sibylline books can be read with advantage even in these days.

DREDGING OPERATIONS AT COCONADA.—The local authorities, as well as Government, appear to be in a mist in regard to the present dredger at work and others proposed for the improvement of the river bar. It seems to be generally acknowledged that a system of permanent dredging is required to keep open the communication across the bar, and extra dredging plant is necessary; but as the dredg-

er now in use has not been worked up to its full power, it is suggested that all that is requisite at present is to sanction one additional dredger with punts. The cost of a new dredger of Priestman's type and of the extra dredging plant required, may be taken approximately at Rs. 32,000.

AGRICULTURE AND RAILWAYS AND THE WELFARE OF INDIA.—Agriculture and Railways are the two most potent agents for the development of the resources of India. They are both the all-absorbing topics of the day, inasmuch as they affect materially the well-being of the subject races, and at the same time enhance the welfare and secure the stability of the English rule. They are the most extensive fields for native intelligence and native energy to work in. They are, moreover, the chief sources through which the comfort and ease for the varied population of India are derived at a small price. They are the fountain-heads from which the stream of prosperity for the British Empire in India constantly flow.

THE BUDGET, 1888-89.—We glean from the summary of the Financial Statement that some details are given in Mr. Westland's "Minute" as to the progress in the construction of Railways, both by the Government directly and by the Indian Midland, the Bengal-Nagpur, and the Southern Mahratta Companies. Altogether more than eight millions sterling will be spent in England and India on Railway Capital Account during 1888-89. It is announced, with the usual reserve, that the Secretary of State proposes to raise fourteen millions sterling by Council Bills, and that the Government in India will raise a rupee loan of three crores, of which half a crore is required for the Calcutta and Bombay Dock Works.

SEEBPORE VERSUS ROORKEE.—A Correspondent writes: "Attention has been drawn to the uselessness of the Seebpore Engineering College. Since then a Committee has been sitting to decide on its usefulness, or rather on improving its usefulness, which shews that the charge is substantially true. It is surprising, however, that what is acknowledged to be a mere 'fad' and inimical to the Roorkee College should still be attempted to be bolstered up. It only goes to prove that the Government cry of economy is a mere feint; and that notwithstanding the sore straits to make both ends meet, there is wilful waste and lavish expenditure. Two lakhs here, a lakh there, and ten lakhs elsewhere soon mount up to a million. Probably there is yet another twist to be given to the screw of the salt tax!"

THE LATE MR. W. BARNFATHER, P. W. D., BENGAL, (RETIRED).—Such of our readers as might have been in Calcutta thirteen years ago will recollect the familiar face and portly form of Mr. W. Barnfather, whose death was reported by the last mail. Mr. Barnfather was a shining light in the P. W. D., with which he was connected for years, and some of the stately edifices that have justly earned for the metropolis of British India the sobriquet of "City of Palaces" are mementoes of his knowledge and ability. An out and out first-class Engineer, he was invariably consulted by his brethren on intricate and knotty points arising in professional practice, and his advice was always cheerfully given. Notwithstanding his very big size, he was, even in the decline of life, as active as any young man fresh from College. His genial disposition, affability and kindness of temper will ever be remembered by those who had the pleasure of knowing him intimately.

SIND RAILWAY EXTENSION.—The *Sind Gazette* on this subject says:—The projectors looking at the net earnings

of the North-Western Railway on the west and of the Rajputana-Malwa Railway on the east, and assuming that only 560 miles of the proposed line in the provinces of Sind and the Punjab would yield net earnings at this average rate, and that the 490 miles of Rajputana are an absolute blank as regards local traffic, calculate that the total net earnings of the proposed line would be equal to $4\frac{1}{2}$ per cent. on the capital outlay, this calculation being based upon net earnings and therefore proceeds on the assumption that the working expenses of the proposed line would be at the same rate as those of the North-Western and Rajputana-Malwa Railways. It is probable, however, that the expenses of the proposed line would always bear a lower ratio to goods earnings than on the North-Western Railway which has to bear the heavy cost of curbing and controlling the Punjab Rivers, or than on the narrow gauge Rajputana Railway.

HIGHER EDUCATION IN GERMANY AND INDIA—A COMPARISON.—Professor Forrest, of Bombay, when he went to Europe lately on three months' privilege leave, made it his business and pleasure to enquire thoroughly into the system of higher education and technical education in Germany. In a recent lecture he gave the results of his experiences, and they were most interesting and most instructive. "The most important lesson," says Professor Forrest, "that I learnt during my recent tour in Germany was the one that it was not by technical education alone, but by technical education grafted on a sound system of general education, that Germany has made the progress in manufactures which now makes her so formidable a competitor to all nations." He concludes: "If we wish to convert the carping parochial spirit of the hour into Imperial patriotism, we must follow the example set us by Germany, and make our Colleges and Universities real, that is, productive as well as receptive centres of learning."

UNPLEASANT INQUIRIES.—It appears from Sir John Gorst's replies to Commander Bethell's inquiries in the House of Commons that the attention of the Secretary of State for India has been directed to the report on the loss of the steamer *Sir John Lawrence*, addressed by the members of the Marine Court of Inquiry to the Government of Bengal. This report stated, that upon the evidence given in the inquiry, not only was the *Sir John Lawrence* carrying more than her proper complement of passengers, but that "every inducement exists for the captains or even for the owners of the vessels engaged in the Chandbally trade to avail themselves of the opportunity to carry more than the licensed number of passengers;" "that the method of survey adopted under the auspices of the Port Commissioners and port officers is extremely unsatisfactory and in urgent need of speedy and thorough reform." Sir John Gorst told the House that the Government of Bengal has already taken measures with a view to correcting these abuses.

"A BLASTED WALL."—We are informed that since Mr. Harris took his departure from Bombay on 5th February last, Mr. W. H. Blackmore, one of Messrs. Kirby and Co.'s (the Dock Contractors) Assistants, has continued and completed the destruction and removal of the barrier wall across the connecting channel between the Prince's Dock and the Victoria Dock without any hitch in the operations. To accomplish this the following additional charges were exploded, *viz.*, three charges in canisters, each charge consisting of $4\frac{1}{2}$ lbs. of dynamite and 6 lbs. of blasting gelatine fired in the remaining three boreholes; nine charges of 7 lbs. each fired in the broken

wall; 17 charges of $3\frac{1}{2}$ lbs. each and 14 of 2 lbs. each were fired as local charges in further breaking the wall into fragments and as face charges for levelling down the bottom. The work was finished and available for ships to pass to and fro from one dock to the other on 27th February 1888. The total amount of explosives expended in the destruction of this wall was about 650 lbs. All the charges were fired by electricity.

PUDUKOTA, 1886-87.—The expenditure on public works in this native State was hardly satisfactory, as the unexpended balance to be worked out next year rose from Rs. 23,936 to Rs. 41,815, or very nearly two-thirds of the amount spent. The expenditure on irrigation works, Rs. 8,066, shewed a considerable falling off. Roads cost some Rs. 25,000 less, but as they are all in excellent condition, the decrease was judicious. The expenditure includes expenses connected with a rough estimate of the cost of a railway from Trichinopoly to Pudukota. The estimate amounted to Rs. 10,41,000, and it seems improbable that anything more will be done, as the line could hardly pay. The outlay on buildings was also very much less than was provided for. A competent Engineer has now been engaged, and it is expected that considerable progress will be made during the current year, in drawing up schemes and preparing plans for a series of large public works which it is proposed to carry out specially. The Government trust that the State will derive great benefit from his appointment.

THE PUNJAB FORESTS.—The Lahore paper observes that on the success of the system of re-clothing again the wastes of this Province, which the neglect and wasteful usage of centuries have reduced to their present hideous barrenness, the agricultural future largely depends: either in the way of supplying fodder for cattle, in increasing the rainfall for the crops, or in providing fences and safeguards against the destructive torrents in the rains. The people little appreciate the amount of good which the Forest Department is effecting for them: for, in addition to the excellent undertakings enumerated above, it must be remembered that one-half of the profits of the forest-work is absorbed by free-grants and right-holders, and, though it does not appear in the Report, all goes towards the sum of general prosperity in the country. In return for which, such is the ingratitude of ignorance, the cultivator has only complaints against the Forest officers where they are strong enough to keep him in order, and incendiary malice, where they are weak; besides being incurably careless and improvident in all his dealings with fodder or fuel. Probably never in the history of the world was such a philanthropic undertaking carried on with so much labor in the face of such difficulties with so excellent a financial result.

INDIAN RAILWAYS.—The Bill just passed introduced by Sir John Gorst for empowering the Secretary of State for India in Council to raise money in the United Kingdom for the purchase of the Oudh and Rohilkhand Railway, authorizes to be raised in respect of that object £10,336,048 16s. 8d. Another matter is also dealt with by the Bill. Large sums of money have from time to time been raised on bonds or debentures for the purpose of constructing, extending and equipping various railways in India by companies under the guarantee of the Indian Secretary. He is, however, advised that the charge on the revenues of India on account of such moneys might be less if they were raised by the Secretary of State himself on the credit of the revenues of

India than if they were raised through the agency of the companies. The Bill, accordingly, empowers the Indian Secretary of State to raise in the United Kingdom any sums of money not exceeding in the whole ten millions sterling, to be applied from time to time, as he may determine, for the purpose of constructing, extending, and equipping railways in India through the agency of companies under engagement with the Secretary of State, or in the repayment or discharge of the principal of any bonds or debentures issued by such a company under the Secretary of State's guarantee.

THE VICTORIA TERMINUS, G. I. P. R., BOMBAY.—The Victoria Terminal Buildings may be said to have reached the stage of completion with the recent uncovering of the statue of the Queen-Empress. The *Bombay Gazette* says: "The event passed in an entirely undemonstrative way, just as the new Victoria Dock received its first steamer the other day in solemn silence, unrecognized by the public and the authorities. This seems to be our Bombay way now-a-days, and we think it practical, business-like, and nobly unsentimental. But they manage things better in Bengal and everywhere else. They are not altogether unbusiness-like on the other side of India, and yet when they have to inaugurate a big bridge there—as for instance the Hooghly and Benares Bridges—the occasion is deemed worthy of some public recognition, the Viceroy attends, and the Engineers receive due honors at the hands of Government." The buildings are unique in their kind, and as a splendid monument of the railway era in India it seems as much against the fitness of things as against precedent to treat the completion of them as unceremoniously as the completion of an engine-shed. However, the building itself is as eloquent as the most eloquent speeches that could have been made in consecrating it to public use. We hope to furnish full illustrations of this magnificent pile in an early issue.

"EUROPEAN MANUFACTURES."—Certain advertisements issued by the Superintendent of Army Clothing, Madras, for tenders for the year 1889-90, have more than once formed the subject of inquiries by representatives of northern constituencies in the House of Commons, and the Secretary of State has admitted that the expressions used in the advertisements are "misleading." Thus in paragraph 3 of the specifications it is set out that "articles of European manufacture are not required." Hence Mr. J. Hoyle asked the Under-Secretary for India, whether those terms would exclude goods made in Lancashire and Yorkshire, while they freely admit goods made in the United States of America. Sir John Gorst admitted that that was the effect of the provision, though as regards goods from the United States the advertisement is not likely to have any practical consequences. Mr. Hoyle further asked whether the Secretary of State for India would feel obliged, in the interests of the public service, to cancel any and all contracts entered into in contravention of the pledge given to the House on the 10th March 1887. To this Sir John Gorst replied negatively, adding that such a course would not, in the opinion of the Secretary of State, be for the interest of the public service, and that the Secretary of State is very doubtful whether even he has the power. Then Mr. Howell asked whether it was intentional that goods manufactured in the United Kingdom should be excluded. "No, Sir," replied the Under-Secretary: "I think I have answered that question several times before. It is not intentional."

Current News.

SIR E. BUCK left Calcutta for the Delhi Conference—over which he will preside—on the 26th instant.

It is reported that Mr. Mackenzie is maturing a scheme for a Technical College for the Central Provinces.

THE Pagan oil-wells in Upper Burma have been leased to Messrs. Finlay and Co., of Rangoon, as Agents for Mr. D. Cargill, of Glasgow.

THE want of rolling-stock on the Burma State Railway is very much felt at almost all the large stations along the line, especially during this busy season.

COLONEL H. A. J. WALLACE, Director, and Mr. C. Sandiford, Locomotive Superintendent, of N.-W. Railway, left Lahore for Quetta to inspect the Railway line.

MAJOR FLETCHER, Superintendent of the Gun-Carriage Factory, Madras, goes home on leave next month. Captain C. Townsend from Bombay will probably succeed him.

OFFICERS and Engineers of the Indian Marine, on special duty in England, will, on arrival in England, receive the full pay of their grade *plus* subsistence allowance.

CAPTAIN W. G. BOWYER, R.E., has been appointed to officiate as Secretary to the Defence Committee during the absence of the Secretary on privilege leave.

THE Governor of Madras in opening the Salem Agricultural show, alluded to the great importance of agriculture as a basis of further prosperity to this Presidency.

IT is said that the portion of the Secretariat buildings which was destroyed by fire in November last, will be completed for re-occupation by July or August next.

A SHAREHOLDER of the Indian Railway Feeder Lines Company is glad to be able to assure the public that good progress has been made, and that there is no cause for anxiety.

WE believe that Mr. Phillips, the Assistant Locomotive Superintendent of the Insein Workshops, shortly leaves for Yamethin, to superintend the erection of the workshop that is to be built at that place.

UNDER instructions from the Government of India the services of Major W. Osborn, R.E., Executive Engineer, first grade, have been temporarily placed at the disposal of the Government of India, for employment on the Defence Works at Aden.

THE Colombo Chamber of Commerce have condemned Mr. Shelford's proposed routes for railway relief to Uva, and also pressed for extension to Haputale on the existing gauge because of its apparent imminence.

THE Irrawaddy Flotilla Company's salvage steamer, the *Rescue*, was successfully launched at Dalla last week, and she will shortly be fully equipped with her apparatus for raising sunken flats and steamers, and for towing flats when required to do so.

WE understand that, owing to the want of funds, the Bombay Government has expressed its inability to co-operate at present in the scheme proposed by the Imperial Government at the beginning of last year, for the systematic botanical exploration of India.

A FIBRE extracting machine, presented to the Government of India by Sir Walter de Souza, has been despatched to the Andamans, where it will be tried on the fibre of the *musae textilis*, the cultivation of which has been successfully undertaken there.

SIR Charles Elliott arrived at Allahabad on last Saturday evening, and was met by Colonel Ward and Colonel Forbes, representing the local Government. He left again on Sunday evening for the Central Provinces, accompanied by Colonel Conway Gordon.

COLONEL CONWAY GORDON, R.E., left Calcutta last Saturday night, and will join Sir Charles Elliott on tour before proceeding to Simla. Major Sergeaut left by the same mail for Bombay to relieve Colonel Firebrace as Consulting Engineer for State Railways.

THE idea of bringing an expert from France to investigate the Bengal silkworm disease having been abandoned, the local Government has now, it is believed, under consideration, the question of deputing one of the returned Cirencester men to study the subject at a silk-breeding establishment in France.

MR. TREVITHICK, Locomotive Superintendent, Perambore Works, Madras Railway Company, has been granted one year's leave on furlough, from 1st April next. Mr J. W. Mellis, Assistant to the Agent and Manager, Royapuram, has also been granted one-and-half year's leave, and Mr. F. W. Read, District Traffic Officer, Arkonam, has been appointed to act for him during his absence.

A SCHEME for the reclamation of waste land in the Jhansi Division, by the construction of bunds across ravines to hold back the drainage water, is about to be carried out. An expenditure of Rs. 11,000 has been sanctioned for the experiment, which is to be under the charge of Lieutenant-Colonel G. M. Belasis, the Executive Engineer of the Jhansi Provincial Division.

THE report on the administration of the Opium Department of the Bombay Presidency for the revenue year 1886-87 shews that the cultivation of the poppy and the manufacture of opium are now prohibited throughout the Presidency, the State of Baroda excepted. The bulk of the opium imported into Bombay is grown and manufactured in Native States in Malwa and Rajputana.

ANOTHER Indian gold mining company—the Mysore Reefs—finds itself without funds to go on. A circular has been issued stating that the amount of capital remaining unexpended is insufficient to carry out the work contemplated, and that it is necessary at once to provide additional funds for continuing the development of the property and for the erection of crushing and other machinery.

A SERIOUS accident occurred below Tinpahar on the loop-line of the East Indian Railway on the morning of the 18th instant. Number 59 up-goods train left Barharwa at about 8:30 and was badly derailed at a bridge which spans a stream named Dhan Dhonia some three miles from Tinpahar. Several wagons were completely smashed, the bridge itself was badly damaged and the line was blocked. Fortunately no lives were lost.

THE river Indus has for some years past been shewing a tendency to encroach in the direction of the N.-W. Railway, some 25 miles below Sukkur; and its right bank having now approached within a mile of the railway, preparations are being made in advance so as to have everything ready for a retreat, should it be deemed advisable to lay the rails further inland in the event of the river proving abnormally aggressive next flood season. Hitherto the rate of advance of the river westwards at the point threatened has been from half to three-quarters of a mile per annum.

THE Bengal Public Works Department have rendered valuable aid to the military, with the Sikkim expeditionary force. Mr. J. C. White, Executive Engineer, Darjeeling, and Mr. Green, Assistant Engineer, have been the officers engaged on works sanctioned by Government; and Mr. Anley, Superintending Engineer of the Eastern Circle, has had the general control. The halting accommodation at Silligori, Sevoke, Riang, Kalimpong and Padong was provided at very short notice. The road from the Teesta Bridge to the Rishi River has been widened under his direction to 12 feet, and new diversions made so as to give a uniform gradient of 1 in 15.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.

A PRIZE COMPETITION.

Sir,—I have the honor to enclose a circular issued by the Belgian Government with reference to a prize competition which is to take place in 1892, with a view to your giving it such publicity as you may deem of interest to the readers of your widely circulated paper.

F. MASOTTI,

Consul for Belgium at Bombay and Acting
BOMBAY; March 20. Consul-General for Belgium in British India

By a decree of the 14th December 1874, His Majesty the King of the Belgians, purposing to encourage intellectual works, has instituted an annual prize of francs 25,000.

The prize accessible to international or universal competitors shall be awarded during the year 1893 to the best work in competition, which shall bear on the means of procuring the best potable water in abundance and at the least cost to large towns, and specially to the whole city of Brussels, anticipating a progressive increase in the number of inhabitants.

The said work may be printed or manuscript. The new edition of an already published work on the subjects shall be appraised only upon the importance of additions and improvements it may contain with respect to rival works that may appear within any one of the other competitive periods of 1889, 1890, 1891, or 1892.

Foreigners desirous of competing for the said prize shall send in their works, composed in either the French, Flemish, English, German, Italian, or Spanish language, to the Minister for Agriculture, Commerce, and Public Works before the 1st of January 1893.

The work carrying the prize shall be published during the year following that in which the prize shall have been awarded.

The judgment of the competing works shall rest with a jury of seven members, three of whom shall be Belgians, and the other four foreigners from different nationalities to be nominated by His Majesty the King of the Belgians.

FIRES IN THEATRES.

SIR,—The Russian may be *au fond* a Tartar veneered over with French polish; but he seems to have sounder notions about the building of a model theatre than his English critics. One such

Thespian temple was opened at Odessa last December. In fifteen seconds the body of this theatre can be altogether separated from the stage by the drop of an iron curtain. The auditorium is heated with hot air; all the rest of the building with hot water. The electric is the only light used; dynamos and engines for its generation being located a mile away from the premises. Water is laid on all over the theatre. In the lower parts it is supplied direct from the town reservoirs, and in the upper parts from three iron tanks on the roof, fed by a steam pump. The stage is not only separated from the auditorium by the iron curtain, but also from the back premises by automatic iron doors leading into fire-proof corridors, which in their turn are divided from the dressing-rooms by iron doors. The flooring of the whole building is made of iron—with view possibly to parched peas on a gridiron in the unlikely event of fire. Meanwhile, I commend the Odessa plan to the consideration of those gentlemen amateurs who are usually entrusted with the construction of theatres in India, and who have happily no record of fire disaster to serve as warning post in the direction of their architectural designs. Far be it from me to suggest disaster therefore. But there is *souppçon* of wisdom in the French proverb which suggests that in real life it is only the unforeseen that happens.

PLAY-GOER

PROVINCIAL AND LOCAL PUBLIC WORKS—N. W. P. AND OUDH.

SIR,—I think that we have now arrived at the second stage when a readjustment of some of the wheels of the machine is absolutely necessary.

The Superintending Engineers do not realize apparently the value the Divisional Engineers are to them. Under the new organization they, the Divisional Engineers, are Superintending Engineers of their divisions; but the misfortune is that the Superintending and Divisional Engineers have separate offices, and great delay occurs in all matters where District Engineers are concerned, and correspondence passing through the Divisional office.

It appears to me that matters can be very much simplified, and greater efficiency obtained, by amalgamating the S. E. and D. E. offices.

The Superintending Engineer would then be the Chief S. E. of his circle, having one, two, or three Assistant Superintending Engineers under him to assist him in inspections and the preparation of projects. If this system be adopted there would be a great saving of paper, and work would be got through quicker, and there would be a greater check over the District Engineers. Another thing is this, in some divisions it seems that the Divisional Engineer is still the Secretary to the Commissioner. I think that this should not be. The Divisional Engineer has really no time to fiddle over re-appropriation returns and petty references made to him by the Commissioner. All this sort of work should be managed between him and the Civil District authorities.

R.

GOVERNMENTAL VAGARIES AND THE P. W. D.

SIR,—You have several times commented on the need of a Rational System of Public Works, and I am sure many besides myself have endorsed the sentiment in the most emphatic manner possible, though your view of the subject is necessarily from an Imperial, while ours, as individuals, is from a Provincial standpoint. Ever since the fertile brain of Lord Ripon's Government hatched that administrative hen which was to lay the golden eggs of economy, Social and Political progress, and all the cognate virtues under the wooing influences of local self-government, we have been much in the same attitude as the conjuror's parrot who was taught to say after each feat "That's a good trick, what next!" But one day a lighted match falling accidentally on a gunpowder barrel transferred Polly to the top of a steeple, and though true to her salt she did not forget her usual bit of applause, yet one cannot view with equanimity the prospect of a similar perch. It is impossible to predict what the next move may not be. But as rational beings I think it time a protest were made against the one-sided shuffling, which we have been the victims of during the past five or six years.

I remember as far back as 1876 some of our district administrators airing their notions about the independence of the P. W. D., and the consequent waste and extravagance. The introduction of the local self-government scheme offered a "grand opportunity for correcting these abuses, and accordingly a special or select committee was convened to fix the relation of P. W. D. officials to district bodies. The report should be preserved for the edification of future generations, to shew how prejudice may sway a symposium of geniuses. It called forth a rebuke from the provincial head, but the recommendations were allowed to stand, and so District Engineers became "servants" of local bodies. The question often asked was, Why gentlemen belonging to a profession submitted to the humiliation of being subordinated to a collection of semaphores? The best reply would probably have been that there was something so truly ridiculous about the whole thing that, like the conjuror's parrot, our loyalty compelled us to exclaim, "That's a good trick, what next!" The whole scheme as represented by a number of bulky circular files was a magnificent display of mental elasticity. Less gifted individuals would have bluntly explained the scheme in a few words thus:—"The first great principle is the study of metaphysics in so far as that

science relates to the idiosyncrasies of District Boards; and the second great principle is—likewise. On these hang true success and progress. Boards may be defined as ghostly apparitions to be seen at uncertain intervals, and consisting of a table with a beak at one end and spectres for an audience." If these bulky volumes of circulars had only been thus epitomised, some of us might still be wearing the honors gained in other days when success and progress rested on the P. W. D. Code and Engineering Treatises.

It is not my present intention to dwell upon any of the episodes which mark the history of nearly every district during the first five years of "local stuff," though a volume of such would be very suggestive and instructive.

When the five years' farce drew to a close, the District Engineer was good-naturedly brought out of his obscurity, and, as the order ran, was to be subject professionally to the Divisional Engineer, and administratively to the Chairman. The conception was well meant, but unfortunately it rested on impracticable premises. "No man can serve two masters" is as true to-day as when first uttered. A twelvemonth's experience with its bickerings and fightings has fully demonstrated this, if demonstration were necessary. It is very obvious that the promoter of the present modified system foresaw the troubles likely to arise and hoped to obviate them by drawing as distinct a line as possible between administrative and professional duties. In theory nothing would seem easier than to fix such a line, by saying that when a work is commenced the administrative gives place to the professional. But theory and practice often vary, and many of us know from annoying experiences that the terms are misleading, being practically synonymous. I could give instances of Chairmen who have felt at liberty to interfere with the details of works in progress, even going so far as to condemn the work! What is the result? The Engineer protests, the Chairman gets his back up—correspondence ensues—the oracles are appealed to, and the answer comes that the Chairman cannot err, and that the District Engineer is marked as a quarrelsome fellow. And this is how he comes to learn the full meaning of the word "administrative."

Now I think as professional men we are entitled to protest against the principle of subordinating us in professional matters to non-professionals. A Chief Engineer has his civil superior in the Lieutenant-Governor, and a Divisional Engineer his in the Commissioner, but neither of these civil officers would dream of dictating to their advisers, for the simple reason that they recognise them as possessing knowledge and experience which they themselves do not possess. And it is only by a proper recognition of this truth that these officers could continue to work amicably together. By a parity of reasoning the District Engineer should hold the position of Adviser to the District Board, and to enable him to act efficiently as such by commanding respect for his opinions, he should be quite independent of that body, being as a district official nominally under the Collector's control as in the case of the opium officer. This plan was tried prior to 1882 and worked satisfactorily. There is not the smallest advantage to be gained in subordinating a District Engineer to a Chairman. The Chairman is interested in the proper allotment of district funds, and he should have full liberty to do this; but having signified how he would like the money spent the rest might safely be left to the Divisional Engineer, who is always an officer of long experience and ability. He alone can exercise an *intelligent* control over the District Engineer. Give Chairmen power to interfere and they *will* interfere—ostensibly in the interests of the district, but too often to satisfy a whim, personal spite, or as the result of wire-pulling on the part of sycophants. These are plain words, but are based upon experience. But even granting that such interference is based upon the most irreproachable grounds, what guarantee is there that the interference will not be a blunder? The works of a district are not unlike a machine the interference with any part of which affects the whole. How can a non-professional man be expected to know this? A Collector can in blissful ignorance of consequences stop a work in progress, or interfere so as to practically stop it. What can he know of the time and trouble gone to in maturing a project and getting all the wheels connected with it into motion. He may ask for a work to be stopped for a few days in happy unconsciousness of the loss to a contractor such a stoppage means, and of the additional trouble it will give the District Engineer to get those wheels into motion again. He may by his inane interference drive good contractors out of a district, men perhaps whom the District Engineer has been at great pains to secure. He may do all this, and more, and in nine cases out of ten an attempt to enlighten him as to consequences, will be misunderstood and the Engineer pronounced "obstructive." I repeat that it is extremely unjust to place any man in this wretched predicament of having to serve two masters, and especially so when one of them—through ignorance and absence of responsibility—is not qualified to exercise that tact, sympathy, and other essentials so necessary in a superior.

In the name of reason, let us have an end of this system of sacrificing efficiency to symmetry or other fanciful or ill-digested object. Let it be recognised that there is a great difference between the work of an Engineer and that—say of a police officer. A civil officer may be competent to judge of a police officer's capabilities; he cannot be in a position to do so of an Engineer. Let an Engineer have an Engineer officer to deal with, and thus put things on a rational basis.

RATIONAL.

Literary Notices.

STENOGRAPHY.

WE have perused with much interest a small pamphlet by Mr. Baness of Bangalore, containing the alphabet, contractions, vowels, and rules for writing, a new system of Stenography based, apparently, on a scientific and at the same time easy method. A practical acquaintance with that most complex system of short-hand, Pitman's, and a comparison of it with the system exemplified in the little pamphlet before us, enables us to say that the latter can be acquired after the course of a few days' study. Mr. Baness has avoided going too much into detail and has, after formulating a few arbitrary rules, given some clear hints for the student's future guidance. Some of the rules of writing are very ingenious, and to all appearances, the characters seem to conduce to ease and rapidity of writing, and, what is of much more importance, ease in deciphering. To master the "Stenographic demon" is no easy task, and a certain amount of patience, intelligence, and labor are essential in mastering any system of shorthand. Bearing this in mind, and also having knowledge of the fact that most of the popular systems of this difficult but beautiful art are fenced in with a great number of arbitrary rules, and contain some thousands of contractions which must always be at one's fingers' ends, the little pamphlet we are noticing will prove very useful, and we cordially recommend it to any one desirous of studying shorthand.

THE VOSBURG TUNNEL. New York: Leo Von Rosenberg. 1887.

THIS pamphlet is a valuable record of the construction of a gigantic work located on the line of the Pennsylvania and New York Canal and Railroad. The tunnel is 3,902 feet long and about 28 feet by 21 feet in cross section. The technical details furnished are very full and replete with interest. The description is illustrated by 72 engravings and several maps, carefully prepared and executed in the best style of American art. The publication contains much matter of general interest, and should find a wide and ready sale at the modest price of one dollar.

New Books and Reprints.

ENGINEERING AND MECHANICS.

- ADCOCK'S, Engineer's Pocket Book for 1888, 12mo, tuck, Simpkin . . 6/
 ANDERSON, (J. W.) Prospector's Handbook. 3rd ed. Cr. 8vo. Crosby
 Lockwood 3/6
 CHURCH, (I. P.) Mechanics of Materials; Treatise on the Elasticity
 and Strength of Beams, Columns, Arches, &c., for Students of
 Engineering. Illust. 8vo. New York 12/6
 DORSEY (E. B.) English and American Railroads Compared. With
 Discussions by W. W. Evans, T. C. Clarke, and E. P. North. 8vo.
 New York 6/6
 FORBES, (George) A Course of Lectures on Electricity, delivered before
 the Society of Arts. Post 8vo, pp 162. Longmans 5/
 FORD, (W. H.) Boiler-Making for Boiler-Makers: A Practical Treatise
 on Work in the Shop, showing the Best Methods of Riveting,
 Bracing and Staying. Punching, Drilling, Smelting, &c.; and the
 most Economical Manner of Obtaining the Best Quality of Output at
 the Least Expense. 16mo, pp. 203. New York 4/6
 GRIMSHAW (R.) The Pump Catechism: A Practical Help to Runners,
 Owners and Makers of Pumps of any Kind, covering the Theory and
 Practice of Designing, Constructing, Erecting, Connecting and Ad-
 justing. 6mo. New York 4/6
 KUNHURDT (C. P.) Steam Yachts and Launches: Their Machinery
 and Management. A Review of the Steam Engine as applied to
 Yachts, Laws governing Yachts in American Waters, Rules for
 Racing, Rules for Building, Pilot Regulations, Specific Types of Ma-
 chinery, Designs of Hulls, &c. 8vo, pp. 224. Low 16/
 LUKIN (James) Turning Lathes: A Manual for Technical Schools, and
 Apprentices: A Guide to Turning, Screw-Cutting, Metal-Spinning,
 &c. With 124 Illusts. Edit. by James Lukin. Post 8vo, pp. 138,
 Spons 3/
 PINKERTON (R. H.) An Elementary Text Book of Dynamics and Hy-
 drostatics adapted to the Requirements of the Science and Art
 Examinations in Theoretical Mechanics. (Blackie's Science Text
 Book.) 12mo, pp. 276. Blackie 3/6
 THOMPSON (S. P.) Development of the Mercurial Air-Pump. Roy.
 8vo. Spons 1/6
 THURSTON (R. H.) Steam Boilers in Theory and Practice. 12mo. New
 York 63/
 WALMSLEY (A. T.) Examples of Iron Roofs. With Drawings to a
 Large Scale. Sm. folio. Spons 63/
 WILSON (F. J. F.) Typographic Printing Machines and Machine Print-
 ing. 4th ed. With numerous Illusts. Post 8vo, pp. 230. Wyman 5/

General Articles.

WRITERS' BUILDINGS, CALCUTTA.

THIS extensive block of buildings may be said to be of historical interest. They were erected by Mr. Bainell, Senior Member of Council in Warren Hastings' time, about 1770—nearly one hundred and twenty years ago, from whom they were first hired, and subsequently purchased by the Government for the accommodation of junior Civilians. In Colonel Wood's map of Calcutta of 1782, Writers' Buildings are clearly marked. They appear there as three separate blocks of buildings lying between Tank (now Dalhousie) Square to the south, and Lyons' Range to the north, in, of course, the position they now occupy. When the "College of Fort William," established by the Marquis Wellesley in 1800 for Civilians to study the native languages, was removed from its original location, where the "Exchange" now is, at the south-east corner of Dalhousie Square, it was lodged in the central portion of these buildings. About 1820, "Writers' Buildings" were greatly improved, and the following extract from the *John Bull* newspaper of August 1821 describes the improvements:—"The Writers' Buildings also, from being remarkable only for the nakedness of their appearance which conveyed the idea of a workhouse or range of warehouses, have been ornamented with three pediments in front, supported on colonades which form handsome verandahs. The centre one adorns the front of four suites of apartments now appropriated to the use of a College, and altered in order to afford the requisite accommodation. The lower floor contains the lecture rooms, and the second has been fitted up for the reception of the College Library, which will thus occupy five rooms, each 30 feet long by 20 broad. On the upper floor the partition walls have been removed, so as to throw the greater portion of the space into a large hall, intended for the Examination Room, which is 68 feet long and 30 broad; the remaining apartment is fitted up for the use of the Secretary. Each of the pediments at the extremes of the building fronts suites of apartments, which will afford accommodation to the Secretary and one of the Professors, the intermediate buildings, eleven in number, will accommodate 22 students. So that the entire range will be sufficient for the College, and the College officers, and as many of the students as are generally found to require accommodation in the neighbourhood of the College." Not long after the above was published, Writers' Buildings were occupied as Government Offices, and have continued to be used as such up to the present time.

In an amusing description in poetry of a Subaltern's experiences in India very cleverly illustrated—called "Tom Raw the Griffin," published in 1828—Writers' Buildings is referred to in the following terms:—

I.

There ! to the northward in one even line,
The Writers' Buildings stand, nineteen in number,
Where young Civilians prosper, or decline,
As study spurs them, or o'er books they slumber,
Or youthful follies haste to disencumber
The thoughtless of their prodigal receipts,
And they were often thought of as live lumber
By their employers in the upper seats.
Thinking much less of Persian than of rakish feats.

II.

In number one, a studious youth is seen
Poring o'er Gilchrist with the moonshee's aid.
In number five, a sporting magazine,
His teacher of the languages, afraid
Of hunting whips, across the table laid,
Shrinks in the corner with demeanour civil,
Requests his *rhooksut* after having staid
Four useless hours, in his own thoughts to revel,
And then he gets, at last, a *rhooksut*—to the devil.

III.

Here Tom alighting, found a jovial crew
Of youngsters round a spacious table placed,
Where peppered devils and a Burdwan steer
Smoked on the board, and courted well the taste.
Pale ale frothed high, and ruby claret graced
The sumptuous tiffin, while some brisk champagne
Sparkling ran down their thirsty throats in haste
The jest went round, the pun, the boisterous strain
Swelled the light heart and overturned the giddy brain.

Writers' Buildings stand upon an irregular shaped plot of ground, bounded by Lyons Range on the north and east, Dalhousie Square on the south, and Clive Street on the west. The mean length of the site from west to east is 746 feet; the width of the east or Lyons Range end 268½ feet; and of the west boundary, 198 feet. The area embraced within the boundaries is about 4 acres.

The works undertaken during the late Sir Ashley Eden's incumbency as Lieutenant-Governor of Bengal were designed with a view to the provision of sufficient and suitable accommodation for all branches of the Bengal Government Secretariat, and to the concentration of the whole of the offices in one group of buildings. On account of various defects in the arrangement of the building, and in consequence of the largely increased number of offices it was called upon to accommodate, Government decided upon the removal of several unsightly excrescences which jutted out from, and disfigured, its south face, and the erection of a new façade in their place. This admitted of a wide verandah, which forms a passage of communication between the different offices, being given along the entire length of the building, as well as carriage porticos at the level of the street, and increased office-room under the mansard roofs of the new central and two end projections. It further allowed of a portion of the main rooms, which was previously screened off as a passage, being utilized. The old building was three storeys in height, and was divided into twenty-one large rooms, 30 feet by 20 feet, and seventeen smaller rooms of exactly half that size, or 30 feet by 10 feet on each of the three floors. Of these latter eleven in each storey contained the stairs. In the alterations recently effected, a central and two end grand stairs have been constructed in three of the larger rooms, and the old stairs have been replaced by new ones in two of the smaller rooms on all three floors with the addition of three extra stairs from the second floor to the large rooms under the mansard roofs. Four of the smaller rooms in each floor are used as passages, between the new south verandah and the office blocks at the back. These blocks stand ten feet clear of the main building, and are connected with it by light iron bridges. By the new arrangement the area of the rooms in the three old floors, exclusive of stairs and passages is 53,400 superficial feet. There are, in addition, a new large room, measuring 86 feet by 27 feet under the mansard roofs, at either end of the building, and one in the centre 100 feet by 27 feet. These give a floor area of 7,344 square feet, and bring the total accommodation in the main building up to 60,744 against 43,200 superficial feet, which was the floor space available for office accommodation before the late changes were made. This increase of over 40 per cent. was, to a great extent, obtained by dispensing with several of the stairs in the small rooms and leaving the latter free to be used for other purposes. Owing to the south-west corner of the site being curved in shape, it was found necessary, in order to keep within the boundary line, and not encroach on the footpath, to introduce an octagonal feature. This is 68 feet in length and breadth including verandahs, and contains three octagonal rooms, each measuring 37 feet across every way. The lower is allotted as a record room, that on the first floor as a general tiffin room for officers, while the upper floor under the domed roof is used as the Bengal Legislative Council Chamber. This latter has an ornamental cast-iron domed ceiling.

It was necessary in dealing with the architectural



treatment of such an extensive frontage (over 800 feet) that the face lines and sky lines should be broken up at judicious intervals, so as to relieve it of the monotonous appearance it would otherwise possess. This is secured by the increased height given to the projecting wings, the varied shapes of the mansard roofs, and the interruption of the straight lines of the parapets by the introduction of pediments over the small intermediate projections, which latter are supported on ornamental consoles, and spring from the first floor level.

The works were commenced and carried on for a considerable time by Mr. W. H. Nightingale, M. Inst. C.E., late Executive Engineer of the 1st Calcutta Division. This officer was succeeded by Mr. J. W. Davies, Executive Engineer. Honorary Lieutenant J. Keane, Assistant Engineer, held immediate supervising charge for some time. He was relieved by the late Rai Bahadur Jadu Nath Roy, Assistant Engineer, who may be said to have supervised the main proportion of the work.

The terra-cotta decorations, which are of excellent quality and include all the statuary in the building, were supplied by Messrs. Stiff and Sons, of Lambeth, London. This being the first occasion upon which architectural terra-cotta was used on a public building in Calcutta. The mansard roofs, and octagon dome are covered with English "Eureka" green slates, also a novelty in this country: the slates were supplied by Messrs. Roberts and Adlard, of London. The ornamental cast-iron ceiling of the Legislative Chamber was supplied by Messrs. George Smith and Sons. The iron framework of the mansard roofs, as well as columns and girders, were manufactured in a satisfactory manner, locally, by Messrs. Marillier and Edwards, of Calcutta.

The building was designed by Mr. E. J. Martin, M. Inst. C.E., F.R.I.B.A., late Architect to the Government of Bengal.

ON THE CONSTRUCTION OF SEWERS IN MADRAS.

BY HORMUSJI NOWROJI, B.C.E.,

Assistant Engineer, Madras Drainage Works.

I.

IN this article it is proposed to record some of the constructive details of the underground drains forming part of the Drainage Scheme of Black Town, Madras, which is being carried out now. The project was designed by Mr. J. A. Jones, M.I.C.E., Engineer to the Madras Municipality. It is not intended to enter into a discussion of the scheme in these articles, but to prevent any misapprehension, it may be premised that the scheme is essentially one of surface character, and the three under-ground drains described in the following pages were necessitated by the physical features of Black Town, which does not present sufficient variation of the levels from south to north to enable the drains to reach the pumping well without going under-ground.

Outline of Scheme.—Black Town, the most important and populous section of Madras, is bounded on the north by the Madras Railway, on the south by the Cooum, on the east by the sea, and on the west by the Buckingham Canal. Running through Black Town, almost due north and south, and parallel to the sea and the canal, are two ridges which divide Black Town into three distinct drainage areas. The well-known thoroughfare, Popham's Broadway, forms the valley line between the two ridges. This portion constitutes the central drainage area; and the ground sloping from the ridges towards the sea on the one side and towards the canal on the other, form the two remaining drainage areas. It is evident then that the configuration of Black Town admits of facilities for the natural drainage of the slopes east and west, which can be collected at various points along the base of the slopes, i.e., along the Beach Road, along Broadway and along Wall Tax Road, which is parallel and next to the canal. But these

streets do not offer the same facilities for natural drainage from south to north. For the completion of the scheme three underground sewers placed along these three streets were necessary. They start from the south end of the town and run through Black Town along these streets until they reach the north end of the town where they turn almost at right-angles and converge to a point before reaching the pumping station, which is immediately to the north of Black Town.

Datum for Levels.—The datum line, to which the levels in this article are referred, is assumed to be 20 feet below the mean sea-level, as fixed by Major De Haviland in 1821.

Description of Sewers.—The total length of the three sewers is $5\frac{1}{2}$ miles. For convenience of reference, they are numbered 1, 2, 3 and 4. Sewer No. 1 passes through Popham's Broadway. Its starting level is 18'63 and its terminating level 18'65. No. 2 sewer intercepts the sewage along the canal. It commences at the level of 23'16 and joins sewer No. 1 at the level of 14'79. Sewer No. 3 has a level of 28'00 at the beginning, and falls to 16'50 before it meets No. 1 and No. 2. A portion of this sewer was previously constructed by the Harbour Works Department to intercept the sewage from the east drainage area of the town, and prevent it from entering the Harbour.

Separation of Storm Water and Sewage.—The sewers are designed to carry off sewage only. Ordinarily all the sewage that is brought down by the surface drains is admitted into the sewers. But an arrangement of cesspools and inlet pipes is provided to prevent a greater quantity of water entering the sewers than their capacity would permit them to carry. All the sewage collected at any one point is conveyed to a cesspool. This cesspool is connected with the sewer by an inlet pipe which is just large enough to discharge the normal flow of sewage into the cesspool. So that during a storm, when the water brought to the cesspool is greater than the capacity of the inlet pipe, the storm-water passes by an overflow to the nearest outlet.

Capacity of Sewers.—In calculating the dimensions of the sewers, Mr. Jones has fixed the consumption of water in Madras at 15 gallons per head, half of which is to be carried off by the sewers in six hours. The population of Black Town, according to the last census, is 130,000, which would give 434 c. ft. as the maximum quantity of water entering the sewers per minute. But the actual capacity of the sewers is sufficiently large to carry away all the sewage of Black Town, on the assumption that each individual uses 20 gallons of water, half of which, as in the previous case, flows off in six hours. This makes ample provision for any prospective increase of population, and also any increase in the consumption of water individually.

Shape of Sewers.—A circular shape was adopted for the sewers. The present sewers are comparatively small in size, and as they carry only sewage, the flow through them at all times will not vary very considerably. It is only with sewers of considerable dimensions, with greatly varying quantities of water passing through them, that the oviform is advantageous. The latter is also more expensive and difficult of construction. The cylindrical is the strongest form that can be adopted for sewers.

Size of Sewers.—The smallest diameter of the sewers is 12 inches, which increases to 18 inches, and 24 inches. Beyond the junction of sewers No. 1 and No. 2 the size is 30 inches, and where No. 3 joins the above, the sewer attains a diameter of 3ft., which is the largest sewer in the system.

Inclination of Sewers.—The strata on which Madras stands in very unfavorable for placing the sewers at very great depths. The soil consists of an extremely sandy and water bearing strata. Even with a minimum fall of $3\frac{3}{4}$ ft. in one mile, the extreme ends of the sewers are twenty feet below ground level, and 8 feet below the permanent level of saturation. To go deeper into the ground

in order to obtain a steeper gradient for the sewers, would have made the construction difficult and the cost would have been considerably enhanced.

Sewer No. 3, which has a gradient of 1 in 700, has been self-cleansing. This sewer has been in operation for the past three years, and inspection of the sewer has revealed no deposit of silt, nor has it been necessary to inspect the sewer for removing any obstruction. Sewers No. 1 and No. 2 have flatter gradients. But the velocity secured for the sewers is nowhere less than 1½ ft. per second. Arrangements are provided for flushing all the sewers.

The two great factors tending to neutralise the efficiency of a good gradient are the road detritus and the mass of vegetable *débris* that find their way into the sewers. The quantity that enters the sewers, and the still greater quantity that is intercepted at the junctions of the surface drains, is a matter for surprise. The sewage, in its course from the house to the underground sewers, passes through a number of strainers; 2½ inches square was found to be a convenient size for the meshes of the strainers. Where meshes were of smaller gauge, the floating mass of vegetable matter rapidly accumulated in front of the grating and closed up the meshes, thus completely obstructing the flow of sewage through them. To prevent this, meshes are now made 2½ inches square, and the chance of admitting small vegetable *débris* into the sewer is accepted as unavoidable. The heavier silt, such as road detritus and earthy matter, is deposited in silt pits placed at various points on the surface drains. Madras roads are metalled by a soft stone called laterite. Macadam is as yet used to a very limited extent only. This circumstance explains the unusually large quantity of silt received by the drains. The abnormal quantity of vegetable matter received by the drains is due to the habits of the Hindus, who eat out of leaves, which serve the purposes of plates. The Hindus also being mainly vegetarians an enormous quantity of the top dressings of the vegetables, &c., is thrown out as refuse.

(To be continued.)

THE MANUFACTURE OF IRON AND STEEL IN INDIA.

IV.

THE weight of the various woods of the Chanda forests is, on an average, 50lbs. per cubic foot, therefore 30 per cent. greater than of the woods (chiefly fir and pine) used in Sweden and Styria for charcoal, the Chanda charcoal being thus specifically heavier is, weight for weight, far more valuable for the smelting of iron ores.

The reasons why specifically heavier charcoal, weight for weight, is more valuable than specifically lighter charcoal are the following:—

(1.) A larger quantity of fixed carbon is comprised in a smaller space, whereby, as is well-known, the pyrometric effect of every description of fuel is raised.

(2.) The larger the specific weight is of charcoal, the greater is its resistance to being crushed, and this consideration is very important in regard to the use of charcoal in the blast-furnace; in general, the dimensions of a blast-furnace should be as large as possible, as thereby fuel labor, and wear and tear are spared, but their limit is determined by the height of the furnace from which all the other dimensions depend. The height of a blast-furnace again depends on the mechanical resistance "capacity" of the fuel to be used, which "capacity" should be great enough to enable it to bear, in the lower parts of the furnace, the whole weight of the smelting column which fills the furnace (namely, the ore, fuel and flux) without being crushed. Coke furnaces are worked most economically, because their height reaches 80 feet, and their outturn of pig-iron can be raised to 85 tons per day. The charcoal blast-furnaces of Styria and Sweden have a maximum height of 45 feet, and produce 20 tons of pig-iron, but the

charcoal of Chanda will allow of a blast-furnace 52 feet high capable of turning out daily from 30 to 35 tons of pig-iron.

Memorandum shewing the principal species of Trees occurring in the Chanda Forests which are permitted to be felled for consumption.

Botanical Names.	Hindustani Names.	Weight per cub. ft. in lbs.	REMARKS.
Acacia Leucophloa ...	Reunja ...	55	*
Do. Catechu ...	Khair ...	75	*
Adina Cordifolia ...	Haldu ...	42	
Albizzia Lebbek ...	Sirus ...	52	
Do. Lucida ...	Sirrus ...	40	
Do. Odorotissima ...	Basseni Sirrus ...	40	*
Do. Procera ...	Safed Sirrus ...	42	*
Bauhinia Retusa ...	Bhoti ...	54	
Do. Variegata ...	Kachuar ...	54	
Do. Malabonica ...	Amlosa ...	42	
Barringtonia Acutangula ...	Salamandar Phal ...	56	
Bombay Malabaricum ...	Semal ...	29	
Boswellia Thurifera ...	Sati ...	33	
Butea Frondosa ...	Palus ...	34	
Cassia Fistula ...	Amaltas ...	59	
Cochlospermum Gossypium ...	Gadbi ...	30	
Conocarpus Latifolia ...	Dhawra ...	61	
Diospyrus Melanoxylon ...	Pendu ...	75	
Gardinia Purgida ...	Ghuga ...	56	
Feronia Elephantum ...	Kawity ...	50	
Gardenia Gummiifera ...	Dekármáli ...	54	
Do. Lucida ...	Do. ...	54	
Do. Latifolia ...	Papra ...	52	
Grewia Oppositifolia ...	Bihul ...	40	
Do. Vestita ...	Dhamin ...	50	
Helicteris Isora ...	Maror Phal ...	40	
Ixora Parviflora ...	Lokhandi ...	45	
Kydia Calycina ...	Baranja ...	42	
Lebidicropis Orbicularis ...	Jarari ...	45	
Ligerstræmia Parviflora ...	Lewdia ...	45	*
Limonia Acidissima ...	Bali ...	60	
Nauclea Parviflora (Stephegine) ...	Keim ...	41	*
Ordina Wodier ...	Ghujahor Moru ...	55	
Phyllanthus Emblica ...	Armla ...	55	
Sleichera Trijuga ...	Kusam ...	68	*
Soymida Febrifuga ...	Rohan ...	65	*
Sterculia Ureus ...	Kulu ...	35	
Terminalia Bellerica ...	Bahera ...	41	
Xylia Dolabriformis (Iron wood of Burmah) ...	Tamba ...	64	*
Zizyphus Xylopyra ...	Ghoti ...	60	

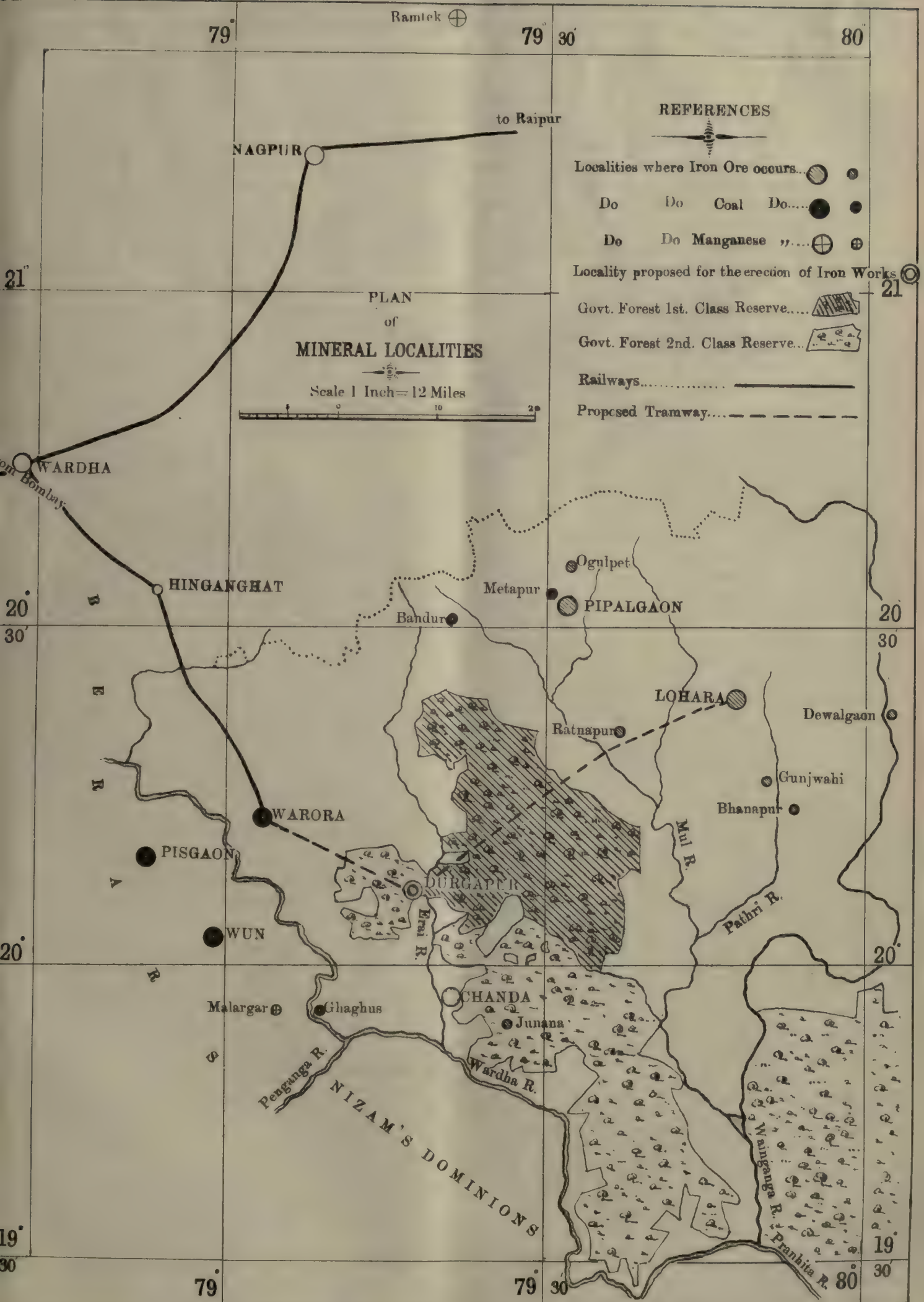
Average weight per cubic foot = 50lbs.

According to an estimation of the Conservator of Forests, Central Provinces, the area of 520 square miles of forest, lying round the site of the projected iron-works, may yield 32,000 tons of charcoal yearly and be regenerated in forty years.

The same authority maintains that the production of charcoal on a large scale, and carried on systematically, improves forests; this, although apparently paradoxical, has been proved by experience in those parts of Sweden and Styria where vegetable fuel is used on a large scale in the production of iron. The reason for this is not far to seek. The products of the forest being in greater demand, and more valuable, the science of forestry has been called in to shew the way to a more correct system of conserving and increasing the contents of forests. The improved and cheaper means of transport, rendered necessary for an iron-work near a forest, render also cheaper the carriage of building timber and other forest produce, whereby they become cheaper; saw-mills and other wood-working machines may be advantageously connected with an iron-work establishment, as this can furnish cheaply the necessary steam-power and supervision.

* Require special sanction of the Deputy Commissioner for being cut.

INDIAN ENGINEERING.



Whilst there is sufficient charcoal in the Chanda forests for the production of pig-iron, the coal of the Wurda-Godavari Valley is good enough for the refining process, namely, the conversion of the pig-iron into finished iron or steel, if the necessary arrangements are made, suitable for this quality of fuel. Judging from borings and out-crops, the sources may be estimated to contain 2,525 millions of tons, of which 1,714 millions are available. The most important seams are those of Wun, Pisgaon, Ghugus, Bunder and Warora.

Of all these coal-fields, however, the Warora seam only is now worked, and produces monthly about 7,000 tons of coal, of which 5,000 tons are bought by the Great Indian Peninsula Railway.

Owing to the small demand for coal the working of this mine is limited; if more use were made of it the working expenses would be proportionally reduced. It is to be regretted that the quality of this coal is not so satisfactory as the quantity.

An analysis of the Warora coal shews:—

	Large Coal.	Slack Coal.
Fixed Carbon ...	45.6 per cent.	35.5 per cent.
Volatile matters (combustible) ...	26.0 "	26.4 "
Volatile matters (not combustible) ...	14.0 "	13.0 "
Ashes ...	14.4 "	24.0 "

The reasons why this coal must be described as inferior quality as regards its fitness for pyrotechnic uses, are:—

- (1.) Its insufficient contents of fixed carbon.
- (2.) Its insufficient contents of hydrogen.
- (3.) Its large contents of ashes.

All attempts to reduce this coal to coke, suitable for the blast-furnace process, have failed, owing chiefly to its deficient proportion of fixed carbon and hydrogen. It is the hydrogen which imparts to the coal the caking quality necessary for its reduction to coke, but numerous trials have shewn that the Warora coal, when heated, does not cake, but crumbles to pieces, which pieces give indeed coke, but of a quality suitable only for forge fires, or for lime burning, and not for blast-furnaces.

The coal of Warora is good enough, however, for producing all the pyrometric effects necessary for re-heating furnaces, and to provide the glow furnaces for Bessemer ingots and sheet iron with necessary heat. This coal is also good enough for the cementation forces (production of blister steel) and the temper forces (the production of malleable cast-iron).

Of the other coal-fields of the Wurda-Godavari basin, the coal of Pisgaon (Berar) appears the most hopeful, owing to its larger contents of fixed carbon. Its analysis is as follows:—

	Large Coal.	Slack Coal.
Fixed carbon...	65.1 per cent.	36.3 per cent.
Volatile matters ...	19.2 "	32.2 "
Ashes ...	15.7 "	31.5 "

The large coal of Pisgaon contains therefore 20 per cent. more fixed carbon than the large coal of Warora; notwithstanding the superiority of this coal, no arrangements have yet been made to work the seam.

For the reasons explained, the reduction of the iron ores of Lohara in the blast-furnace will require 3 per cent. only of limestone as a flux. Excellent limestone for this purpose is to be had in the neighbourhood of Warora; its analysis is as follows:—

Carbonate of lime and magnesium ...	95.0 per cent.
Silica ...	2.5 "
Alumina and oxide of iron ...	2.5 "

Fire-clay of a good quality is found along with the coal in the Warora Colliery; the following is an analysis of this fire-clay:—

Moisture ...	4.10 per cent.
Organic matter ...	4.30 "
Silica (sand) ...	2.40 "
" (in silicates) ...	63.20 "
Alumina (Al ₂ O ₃) ...	18.80 "
Oxide of iron ...	0.50 "
Iron in pyrite ...	1.87 "

Carbonate of lime ...	1.80 per cent.
Alkalis and sulphur ...	2.03 "
Loss ...	1.00 "

This clay is not so good as firstclass English fire-clay, but is good enough for most parts of the iron-melting furnaces.

Near Chanda is also found steatite (Mg. O Si O₂), which, mixed with one-fifth part fire-clay, is well known to give very refractory fire-bricks.

There is in Ramtek (see Map) manganese ore of the following chemical composition:—

Metallic manganese ...	54.60 per cent.
" iron ...	6.50 "
Oxygen in combination ...	26.50 "
Silica ...	6.00 "
Lime ...	1.20 "
Combined water & div. impurities ...	5.20 "

This manganese ore, with the pig-iron obtained from the Lohara ores by means of charcoal, would yield a material for the production of ferromanganese of an excellent quality.

Another manganese ore is found in Malaghar; it is of an inferior quality, and, although nearer, it cannot compete with that of Ramtek.

The amount of iron or steel which can be produced yearly with these raw materials will depend on the quantity of charcoal which the forests near the iron-work can furnish without irretrievable injury to them; this has been estimated at 32,000 tons per year, and with this charcoal may be turned out 25,000 tons of finished iron per year. In case it may be found desirable in the future to considerably enlarge the iron-works, recourse may be had to the more distant forests, situated south and south-east of Chanda, for charcoal for the production of pig-iron. In this case it will be advisable to erect other blast-furnaces near these forests, with the view of reducing iron ores of the contiguous deposits and of conveying the pig-iron thus obtained to the other iron-works, situated nearer the sources of mineral fuel, for the purpose of converting it into finished iron. By these means the whole 3,325 square miles of forests in the Chanda district might make it possible for 260,000 tons of iron or steel being produced yearly.

(To be continued.)

PROPERTIES OF FLUIDS.

By A. EWBANK.

VII.

RETURNING to fig. 7 we saw that while A was yet closed we had a mass of mercury F B E with its free surfaces at different levels F and E. Let O in the C branch have the same level as F in the A branch. Then if we could pour mercury on to E, till the level rose to O, and if the level at F could forcibly in the meantime be prevented from changing, we might then open A and the level at F would have no tendency thereafter to change. Thus with both C and A open we should have a body of mercury F B O. With A closed, we had a body of mercury F B E. When A is open, the space A F is full of air. Before A was opened the space A F was a vacuum. For originally it contained mercury, and the mercury had left it. Thus in the C branch we have a low level E with the air resting on it. In the closed A branch we have a higher level F, with no air upon the surface at F. When we thus have a bent tube with one branch closed, and the mercury in that branch separated from the closed top by a space free of air, we have what is called a barometer.

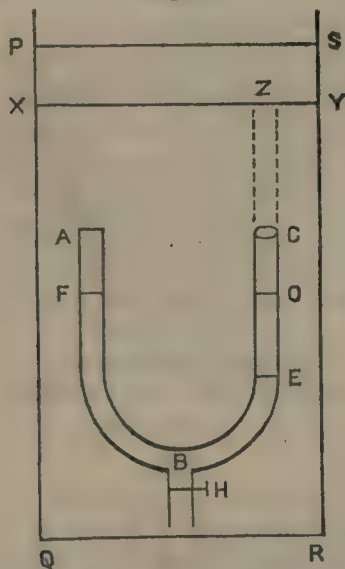
Again, suppose that while there was vacuum above F, and mercury from F to E, we could add a column E O of mercury and have no air pressure at O. Then we should have two columns F B and O B of equal height with no pressures on their free surfaces. These columns should balance each other. If we removed the O B column the lowest particles at B of the F B column would be pressed by the rest of the F B column, and these B particles would move towards the right. Similarly, if we could remove F B, we should have a fluid pressure at B driving towards, to the left, the lowest particles of the right hand or O B column.

When the columns O B and F B are both present, there being then by hypothesis no pressures above F or O, we have the particles at B pressed both ways by the columns F B and O B, and these columns may be said to balance each other at B. Now while the vertical layer of particles at B are thus pressed by two opposing and equal pressures, and there is a vacuum above F and above O, let us imagine the column E O removed. But let us by some other means supply at the horizontal layer E just as much downward pressure as was supplied by the weight of the column E O. If we can thus reproduce at E the same pressure as was caused by the column E O, then no particles below E will be conscious, so to say, that there has been any change above E.

The necessary replacement of pressure could be effected by pouring on E some fluid other than mercury. Suppose we knew of some liquid of which two cubic inches would have the same weight as one cubic inch of mercury possesses. Then if the tube E C is long enough we could place upon E a column of the new liquid. The height of this column must be double of E O. Similarly, a still lighter fluid could be used if we had the tube E C artificially prolonged. There is no limit to the lightness of the new fluid, provided we produce the tube E C to a corresponding or compensating length.

Or we may avoid the necessity of producing the tube E C where such prolongation would be inconvenient.

Fig. 8.



For let us, *fig. 8*, take a vessel PQRS and at the bottom of it fix in some way the bent tube A B C. Suppose A is closed and that there is a vacuum A F. F B E is the column of mercury and E O is as much more mercury as will balance F B without any helping pressure on O. Now E O is to be removed, but a new liquid is to be poured into P R until it rises to the level of C. On continuing to pour we shall have the new liquid entering C and filling the space C E. On continuing still to pour we have the liquid rising to some level X Y.

Then virtually we have a column Z C added to the column C E. If the weight of the column Z C E of the new liquid equals the weight of the column E O of mercury, then the column Z C E of the new liquid will be a perfect substitute for the column E O of mercury as regards pressures at all points below E in the right hand branch, and indeed everywhere in the mercury. It must be remembered that if we thus introduce a new fluid instead of E O we have no air pressure or other pressure above Z. The column E O itself was a fictitious column of mercury which was introduced merely to represent whatever pressure was actually felt at E when the tube C E was open and the space C E was full of air.

Now the air is itself this fluid, whose top surface is at Z. This point Z may be 50 miles or upwards above the surface of the earth. Whatever be the height to which the atmosphere reaches the pressure on any area E is due to as much air as stands on or over that area.

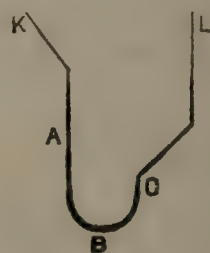
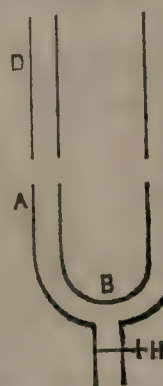
In this experiment we not only ascertain the existence of a pressure at E due to the fluid which we call air. We also measure the magnitude or intensity of the pressure. For the weight of the fluid air, reaching to some unknown height Z above the earth, is equal to the weight of that column of mercury E O, which stands on the same base, *viz.*, the section E of the tube. As F D equals O E, the weight Z C E of air is also represented by F D. If our tube had been wider the pressure of air on E would have been greater. But the height Z E of the air would be the same, also the height E O, or the difference of level between E and F would have been the same. The height E O is independent of the section of the tube. This height E O is called the barometer height. Or it is called the height of the barometric column.

It is assumed that the fluid used in the tube is mercury. With mercury the length E O is about 30 inches. This means that over one square inch of area the atmospheric pressure is equal to the weight of about 30 cubic inches of mercury. Over one square foot of area the pressure is proportionally greater and is equal to the weight of about 2½ cubic feet of mercury. In reality the length E O is generally less than 30 inches, and it is incessantly changing. An experiment made one day will not give the same value for E O as an experiment made a day later. Thus a series of experiments reveals and measures the change in atmospheric pressure.

If we leave the tube with the end A permanently closed the free surface at E will fluctuate. If the air pressure for some reason gets greater, the surface E will descend through some distance x . The surface F must then of necessity rise through some distance y , and thus the difference of level between E and F is increased by $x+y$. If the tube is uniform in section $x=y$. As the pressure at E means simply the weight of air or other matter above E, it follows that if the pressure at E increases there must be an increase of weight of fluid matter between E and Z. This increase might happen in various ways. Similarly if the surface of the mercury at E is seen to rise, we infer that there is a loss of weight between E and Z. The reasons of these changes we may hereafter discuss. At present we merely state that rain and sunshine are both causes of changes in the atmospheric pressure at any small area on the surface of the earth.

Fig. 9.

Fig. 10.



We have assumed that the student could obtain a long U-tube. But he can easily construct a long bent tube out of a short one and pieces of glass tubing. Thus in *fig. 9* the D tube can be connected to the end A by a piece of india-rubber tubing, similarly E can be connected at C. The D and E tubes can themselves be made of shorter pieces similarly joined. Even pieces of different width can be connected by first slipping over the narrower tube a short piece of india-rubber tubing. The experiment does not require in the tube a constant cross-section. A long column thus made of shorter pieces has the advantage that the column can at will be bent into various positions as in *fig. 10*. As we bend the branches with K closed and a vacuum below K, the mercury in each branch will move, but the free surfaces will always so adjust themselves, that the difference of height between them remains unchanged.

NOTES FROM HOME.

(From our own Correspondent.)

THE Report of the Royal Commission on Inland Navigation and Railway matters in Ireland has just been issued. In that portion of the Report dealing with "railway organization," it is pointed out that the railway system of Ireland has proceeded but slowly, and in Ireland there is only 1 mile of railway to 12 square miles of area and 1,800 inhabitants; whereas in Scotland, where the physical difficulties of railway construction are greater, and the population over large areas equally sparse there is 1 mile of railway to 10 square miles of area and 1,200 inhabitants. Comment is made on the general unremunerative character of the railways, and the Commissioners are severe in their comments on the management of Irish railways, and report on the want of adaptation of the system to the wants of the public. The Commissioners come to the conclusion that exceptional treatment and legislation is required. They do not approve of the State purchase of the lines but are strongly in favor of the amalgamation of all the undertakings under the control of one company, the public to be protected by the establishment of a tribunal to be called the Irish Railway Commission. Voluntary amalgamation is recommended, but failing this the State should, after a period of 3 or 5 years, make such amalgamation compulsory.

It appears from the Report of the Metropolitan District Railway that the present position of the Company is in a most unsatisfactory condition; so badly has the line done during the past six months that no dividend whatever was earned on the Preference Stock, and in the current year the full interest may not be earned even on the Guaranteed Stock created to pay for the Inner Circle completion line. This unfortunate state of affairs is attributed partly to the loss of the Exhibitions at South Kensington, and partly to the increased competition of omnibuses. The antagonism that has long existed between this Company and its rival, the Metropolitan, has also cost both much in useless expenditure, and the remedy, indeed the only remedy, for the present failure must lie in bringing about a working agreement to ensure improvement in the relations with the Metropolitan Railway.

A project is under discussion for the amalgamation of the Taff Vale Railway with the Bute Docks, Cardiff. Considerable opposition has, however, manifested itself on the part of some of the shareholders of the Railway, as they point out that the present is an inopportune time for amalgamation to take place, and that the price required for the Docks is above their commercial value.

The *Engineering and Building Record* publishes a few particulars about Mr. Lindenthal's proposed bridge across the Hudson River at New York, and gives a comparative view of the design for it, and that of various other bridges of great span. The proposed Hudson River Bridge, will, if built, greatly surpass even the Forth Bridge, the middle span being 2,850 feet, or more than half a mile from centre to centre of piers. In construction this gigantic affair is intended to be a suspension bridge with cables 40 inches in diameter, those of the Brooklyn Bridge being 16 inches, and the towers instead of being stone, as in the Brooklyn Bridge, and almost all other suspension bridges, are of iron lattice work. These towers are 500 feet high, so that the structure would have a most imposing effect, and with six railroad tracks traversing it, as the plan contemplates, there would be few more interesting structures in the world.

Colonel Hozier recently read an address at the Manchester Town Hall on the Channel Tunnel, in which he considered that if Englishmen were to win back their position as the distributors and the warehousemen of the world, something must be done in the way of bridging or tunnelling the Straits of Dover. Further he considered the scheme would have its military advantages. If we were blockaded and our fleet lost command of the sea, the tunnel would be useful for getting supplies from other countries. This same subject was touched upon in a paper by Mr. Street on "Our National Defences," read before the Civil and Mechanical Engineers' Society, in which the author ridiculed the idea of danger arising from the tunnel, but pointed out the many advantages that would be derived. In the discussion which followed, the feeling was however almost unanimous against the tunnel, the Chairman asking who was to compensate the shareholders in case the tunnel was blown up in time of war.

Messrs. Siemens and Halske have patented a new microphone transmitter, in which the loose contacts consist of hollow carbon cones placed within each other. The object of this

arrangement is to facilitate a change of the surfaces in contact and to prevent deterioration by the action of the current.

The Commissioners of Sewers for the City have rejected the plan to light a portion of the City with electricity, to which I referred in a former letter. The probable reason for the rejection of the scheme is its great expense as compared with gas.

Last week another of the twenty-eight bridges spanning the Seine in Paris gave way. This makes the fourth disaster of the kind within the last five years. First came the Pont Royal, then the Pont des Invalides, then the Pont Neuf, now it is the Pont d'Arcole. There is always a great deal of heavy traffic over it, and it is to this that the Engineers are inclined to attribute its collapse. The Pont d'Arcole is of iron, and, unlike the others, is not an old bridge, having been built in 1856 at a cost of 1,500,000 francs. As a reason for its failure, it is pointed out that it was the first iron bridge ever built in France, and that the Engineers had not then sufficient experience in the behaviour of iron under varying conditions. A hope may, therefore, be expressed that their experience may be now complete, or some apprehension may lay hold of the public as regards the Eiffel Tower, where the safety of a colossal edifice weighing over 6,000 tons is concerned.

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

A NEW tramway for heavy traffic, according to the local *Times*, is about to be tried in New York City, and a section is to be laid of one of its streets where the truck and wagon traffic is very heavy. If this tramway plan is deemed practicable its adoption will work a great change in the movement of freight. Its advantages, as claimed, will be the reduction of traction or pulling force required to move a load on the level to eight pounds on the best stone pavement, reduction of wear and tear of vehicles and roadway in like proportion; avoidance of blockades by reason of higher speed and heavier loading, and consequent reduction in number of teams required for a given traffic; relief to Broadway, the principle thoroughfare, and other crowded avenues, by drawing the heavy traffic to other streets; relief of street car lines from obstruction by wagons; absence of noise, and the possibility of laying a smooth and noiseless pavement in residence streets without attracting destructive business traffic. The objections to all the pavements in use,—the noise of the stone, decay of the wood, and dangers of the asphalt, and the fact that none of them will endure the traffic which a new pavement draws to itself,—as clearly shewn on some of the principal heavy traffic streets and avenues recently paved in New York, may make it expedient now that large expenditures upon the streets are contemplated in that City, to consider a radical change in methods that will bring a better and more durable material into use.

Objection to the cost of a tramway system is met by the fact that a new pavement in a wide avenue like Fifth Avenue would cost \$180,000 per mile, while a double line of tramway would be built and the present pavement relaid for \$50,000, or \$60,000, per mile. The objection as to horses slipping on the rails, is to be avoided by a peculiar arrangement for that purpose. The difficulty apprehended from tearing up the streets to make and repair house connections with sewers, water mains, etc., is guarded against by making the tramway carry its own pavement and serve as a bridge over any trench dug under it.

The old scheme of building a canal around Niagara Falls has been revived. The proposed canal will leave the Niagara River between Buffalo and the Falls, and make a circuit six miles in length. It will, according to surveys already made, cost about \$12,000,000.

The largest gun ever made of steel in one solid casting, and one of the three big guns recently ordered by the United States Government, was recently cast at the works of the Pittsburgh Steel Company. An examination of the mould about an hour after the metal had been poured in was very gratifying to the Engineers and experts.

The casting is not to be taken from the mould for a week. If at that time it is perfect, the gun will be completed and sent to Washington. When completed the gun will be 22½ feet long and will weigh nine tons. If the experiment is successful, it is stated, that guns can be cast for \$3,300 apiece, against \$20,000 on the old plan.

The largest passenger engine ever constructed is now being built in Schenectady Locomotive Works for the

Michigan Central Railroad and is intended for express and passenger purposes. It is a ten-wheel engine, having three pairs of coupled driving wheels and a four-wheeled truck. The drivers are 68 inches in diameter. The cylinders are 19 inches in diameter, with 24-inch stroke. The boiler is of Otis steel and is 58 inches in diameter, has 147 two-inch semi-steel flues. The fire-box is 8 feet long by 42½ inches wide and is placed above the frames which gives increased width. The tank is carried on two four-wheel channel iron trucks and has a capacity of 3,800 gallons. The tender has a capacity of eight tons of coal.

The schemes daily presented for rapid transit in cities are interesting and somewhat ingenious. The Meigs system is an elevated structure of longitudinal single girders on a line of single posts. Four feet below the top of the girder are rails on which grooved wheels run at an angle of 45 degrees to the perpendicular. On the top of the girder is a rail on which wheels run horizontally. This gives stability and steadiness to the cars, and as only ten inches space is required for the horizontal wheels, draw-bars, and other appliances under the floor of the cars the centre of gravity is very low. The tractive power is applied by horizontal driving wheels on the locomotive, which grip the top rail by adjustable hydraulic pressure to suit the varying grades of track or weights of trains. These horizontal drivers suffer no change in pulling power on curves, as ordinary locomotives do, and the Meigs engine having no contraction or exhaust, makes no noise and throws no cinders.

The cylindrical shape of the cars to reduce air resistance, lightness and simplicity of structure to reduce obstructions in the street are some of the features claimed for this system. An average speed of 100 miles an hour between cities is claimed for this plan.

At the first meeting of the American Society of Civil Engineers, held in 1888, Mr. G. Lindenthal, M. Am. Soc. C.E., read a paper on *The North River Bridge Problem, with a discussion on Long Span Bridges*. The paper was a remarkably bold one, and shewed that the author had studied and was familiar with the problem. It was listened to with rapt attention by some of the leading and ablest American Bridge Engineers. The idea is to build a bridge of suspended arches extending from somewhere about the upper business part of New York City to the Hoboken Heights of New Jersey. It would take three years to build it, and would cost about \$15,000,000. He suggested six tracks, and room for pedestrians and teams. It should be 6,500 feet long and built to stand all strain. To carry out his ideas, it would be necessary to erect foundries sufficiently large to make the castings. None now exist on this continent.

Some interesting statistics, in reference to the motive force of engines throughout the world have just been issued by the Berlin Bureau of Statistics, which may be of interest to your readers in India and elsewhere. It appears that four-fifths of the engines now working in the world have been constructed during the last 25 years. France owns 49,590 stationary or locomotive boilers, 7,000 locomotives, and 1,850 boats' boilers; Germany has 59,000 boilers, 10,000 locomotives and 1,700 ships' boilers; Austria 12,000 boilers and 2,800 locomotives. The force equivalent to the working steam engines represents, in the United States 7,500,000 H. P., in England 7,000,000 H. P., in Germany 4,500,000 H. P., in France 3,000,000 H. P., in Austria 1,500,000. In these figures the motive power of the locomotives is not included, whose number in all the world amounts to 105,000, representing a total of 3,000,000 H. P. Adding this amount to the other powers we obtain the total of 46,000,000 H. P. A steam horse-power is equal to three actual horses' power; and a living horse is equal to seven men. The steam engines of the world represent therefore, approximately, the work of 1,000,000,000 men, or more than double the working population of the earth, which amounts to 1,455,923,000 inhabitants. Steam has trebled man's working power, enabling him to economize his physical strength, while attending to his intellectual development.

ONE of the latest novelties in dress, is announced from the States. It is steel lace, made in extremely delicate patterns, and so light that it could almost be blown away by a breath of air. If it were woven of spider webs it could not be much lighter. It is made of steel rolled as fine as the point of a cambric needle, and not woven, but stamped out of a sheet of low grade steel, so that it would not be too brittle.

JOTTINGS FROM MALAYA.

(From our own Correspondent.)

I SHOULD like to give you some news from this out-of-the-way place, as I am confident that it will, if not much, interest you a little.

It is believed that Mr. (now Sir,) Hugh Low will retire during this year; it is yet uncertain who is to be his successor, but the names of Mr. Maxwell, C.M.G., and Mr. Swettenham, C.M.G., (the former is acting Resident Councillor of Penang, and the latter Resident of Selangore) are on the field.

Mr. Creagh, the energetic Assistant Resident, has been appointed Governor of North Borneo, and it is whispered that Mr. Kynersley, the present Chief Magistrate in Penang, will succeed him.

The minor appointments throughout the State were filled up by young blood from Europe or elsewhere with the best recommendations from some one in Singapore or in Larut. These interlopers even come in as clerks, and promotions are totally debarred the old hands.

Mr. Marples, the Treasurer, is getting old and perhaps in a year or two, he will cease connection with the State and retire.

Mr. Scott is still an Inspector of Mines. Mr. Jaysuria has been made an Assistant Surveyor. He is considered by many officials as a man who thoroughly understands his work well.

Father Allard, who was in Larut in the days of old, had been very ill some time ago, and in consequence had to leave and proceed to Hong-Kong for his health, who has returned, and selected Kinta, Upper Perak, as his place of labors. He is now not only agreeing with the climate, but is doing a good mission work.

Mr. Remedios, of the Larut Land Office, has been insane for the last one year or so, and I regret to record the unexpected death of Mr. Ignatio, of the Treasury, Larut.

Mr. Caulfield, the Engineer-in-Chief, has just returned from a long leave of absence. He has two assistants under him. One for the Public Works, and the other for the Survey Office.

All these are men from Ceylon, with the exception of one Assistant Surveyor from India, Mr. Pemberton, whose work in Krian had been very severely criticised by the present Ceylon Assistant Surveyor at Krian. Mr. Caulfield sided with the Krian Surveyor, Mr. Langslow, and condemned the work of Mr. Pemberton, whose case had been pending for these last two or three years, and he was reduced in consequence. I saw him lately, he told me that letters after letters were written to Government calling for the examination of his Krian work, but no reply came. However, he resolved to do it some other way, and finally Captain Cameron, the Acting Colonial Engineer, came over here last month, and he had his works examined by him in company with Mr. Caulfield. I hope ere this that Mr. Pemberton has benefited by the result of the enquiry. According to Mr. Pemberton, he hopes to gain his point.

Mr. Denison, the Superintendent of Lower Perak, is going to England on three months' leave.

Mr. Leech, L.L.D., has been made Commissioner of Lands, quite a new appointment. Dr. Leech is quite fit for the post. Mr. Hewett, who was in Kinta formerly, has come to replace Dr. Leech in Krian.

Larut is not so flourishing just now, as the miners, for the most part of them, have gone to Kinta, in Upper Perak, where tin is in abundance all over the place; and in consequence of the high price of tin, a good many miners made their fortune in a few days.

I think you must have heard that we have a Railway now in Larut, a line from Port Weld (after the name of Governor Weld) to Thaiping. Port Weld is on the right bank of the Larut river; there are now four steamers running regularly to it from Penang. The talked of line to Kuala Kangsa from Thaiping will take years yet before it is commenced.

We are blessed with a tramway in Penang from the jetty to the water falls, 5 miles, and the Company is extending their line to Ayer Itam on the southern side; hence will carry their line towards Ballick Pulvu via Bayalepas. This, when it is done, will be a great work. We must thank our former Governor, Sir Frederick Weld and Captain Cameron, the acting Colonial Engineer.

At Tanisarie, in East Java, coal has been discovered. Experiments made with the "mineral" found there show that it is superior in quality to that shipped from Cardiff.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, March 10, 1888.

Upper Burma.

With reference to *Burma Gazette* Notification, dated the 21st December 1887, Mr. W. W. Robertson, Honorary Assistant Engineer, joined the Shwabo Division on the afternoon of the 27th idem.

Lower Burma.

Lieutenant M. Nathan, R.E., reported his arrival at Rangoon on the forenoon of the 29th ultimo, and is posted to the Public Works Secretariat, Lower Burma, for special duty in connection with the harbour defences of the Port of Rangoon.

Burma, March 17, 1888.

Lower Burma.

The services of Mr. A. W. T. des A. de Crettes, Executive Engineer, 2nd grade, Henzada Division, are temporarily placed at the disposal of the Superintending Engineer, Upper Burma.

With reference to *Burma Gazette* Notification, dated the 16th March 1888, Sub-Conductor J. Watson, Sub-Engineer, is placed in charge of the Henzada Division, as a temporary measure, during the absence of Mr. de Crettes, Executive Engineer, or until further orders. Mr. Watson took over charge on the afternoon of the 12th instant.

Mysore, March 17, 1888.

The following promotion is made in the Engineer Establishment of the Mysore Public Works Department, Local, with effect from the date specified :—

Mr. O. V. Norris, B.C.E., from Apprentice Engineer, promoted to Assistant Engineer, 3rd grade, with effect from 1st April 1888, permanent.

Madras, March 20, 1888.

Public Works Department Notification, published in the *Fort St. George Gazette* of 31st January 1888, granting furlough for eighteen months to Mr. J. P. Davidson, Executive Engineer, 3rd grade, is cancelled.

Public Works Department Notification, published in the *Fort St. George Gazette* of 13th March 1888, appointing Mr. A. A. G. Malet, Executive Engineer, 4th grade, temporary rank, to be Assistant to the Chief Engineer for Irrigation and Under-Secretary to Government, Irrigation Branch, is cancelled.

Mr. C. A. Smith, Executive Engineer, 4th grade, temporary rank, to officiate as Assistant to the Chief Engineer for Irrigation and Under-Secretary to Government, Irrigation Branch, during the absence of Mr. J. P. Davidson on privilege leave, or until further orders. This cancels Mr. Smith's transfer to the Nellore Division, notified in the *Fort St. George Gazette* of 13th March 1888.

Punjab, March 22, 1888.

The Honorable the Lieutenant-Governor of the Punjab is pleased to sanction the formation of a Temporary Railway Division, to be called the "Patiala-Bhatinda Railway Division," with head-quarters at Burnala.

With reference to Government of India, Public Works Department Notifications, dated the 10th and 21st February and 8th March 1888, and in continuation of Punjab Government Notification, dated 21st instant, the undermentioned officers are posted as follows :—

Major W. W. B. Whiteford, R.E., Executive Engineer, 2nd grade, in charge.

Mr. R. L. Campbell, Executive Engineer, 4th grade, sub. *pro tem.*, to the Patiala-Bhatinda Railway Division.

Mr. W. D. Barrow, Assistant Engineer, 1st grade, to the Patiala-Bhatinda Railway Division.

Mr. W. A. Lesmond, Executive Engineer, 2nd grade, temporarily attached to the office of the Superintending Engineer, Patiala-Bhatinda Railway.

Bombay, March 22, 1888.

Under instructions from the Government of India the services of Major W. Osborn, R.E., Executive Engineer, 1st grade, are temporarily placed at the disposal of the Government of India, for employment on the Defence Works at Aden.

His Excellency the Governor in Council is pleased to appoint Khan Sahib Pestanji Hormasji Patuck, B.A., L.C.E., to act as Executive Engineer, Kanara, *vice* Rao Bahadur Pritomdas Parsuram Chandanani, proceeding on furlough.

Mr. P. J. FitzGibbon, Assistant Engineer, 1st grade, is appointed to act as Executive Engineer, Thana, during the absence of Rao Bahadur Khandubhai Gulabbhai Desai on privilege leave, or until further orders.

Assam, March 24, 1888.

The undermentioned officer has been granted by Her Majesty's Secretary of State for India extension of leave as advised in list dated the 21st October 1887 :—

Mr. H. W. Clift, Executive Engineer, Assam, three days' furlough.

The undermentioned officer has been granted by Her Majesty's Secretary of State for India extension of leave as advised in list dated the 12th August 1887 :—

Mr. C. J. S. Baker, Executive Engineer, three months' furlough.

Central Provinces, March 24, 1888.

In supersession of Notification dated 21st ultimo, Mr. J. B. Leventhorpe, Executive Engineer, is granted eight months' furlough. Mr. Leventhorpe availed himself of the furlough on the afternoon of the 19th instant.

N.-W. P. and Oudh, March 24, 1888.

Irrigation Branch.

Mr. J. L. Tickell, Executive Engineer, 2nd grade, Rohilkhand Canals, is granted furlough for eighteen months, with effect from the 15th April 1888, or subsequent date.

The following transfers are ordered, *vice* Mr. J. L. Tickell, Executive Engineer, 2nd grade, who has been granted furlough :—
Mr. R. W. L. Hawkins, Executive Engineer, 2nd grade, sub. *pro tem.*, from the Betwa Canal to the charge of the Bulandshahr Division, Ganges Canal.

Mr. W. V. P. Horst, Executive Engineer, 2nd grade, sub. *pro tem.*, from the Bulandshahr Division, Ganges Canal, to the charge of the Betwa Canal.

Mr. W. Ward-Smith, Executive Engineer, 2nd grade, sub. *pro tem.*, from the Betwa Canal to the charge of the Eastern Jumna Canal.

Mr. C. G. Palmer, Executive Engineer, 2nd grade, from the Eastern Jumna Canal to the charge of the Agra Canal.

Captain J. Clibborn, s.c., Executive Engineer, 2nd grade, from the Agra Canal to the charge of the Rohilkhand Canals.

Buildings and Roads Branch.

In continuation of Notification, dated the 8th March 1888, transferring him to the 1st Circle, Public Works, Mr. R. J. Powell, Assistant Engineer, 1st grade, is posted to the Jhansi District.

Mr. J. Thornhill, Assistant Engineer, 1st grade, Ranibagh-Ranikhet Cart Road Sub-Division, is transferred to the Garhwal District as District Engineer.

Mr. C. H. Holme, Assistant Engineer, 1st grade, is, on return from furlough, posted to the Saharanpur District, Meerut Division Provincial Works.

Mr. A. C. Crampton, Executive Engineer, 3rd grade, is transferred from the Meerut Provincial Division to the Allahabad District.

The transfer of Rao Mohendro Nath Chakrabarti Sahab, Assistant Engineer, from the Allahabad to the Hamirpur District, notified dated 8th March 1888, is hereby cancelled.

India, March 24, 1888.

Mr. H. W. Bennett, Officiating Deputy Consulting Engineer to the Government of India for Railways, Calcutta, is granted furlough for nine months, with effect from the 1st April 1888, or such subsequent date as he may avail himself of it.

Mr. E. J. Toppie, Sub-Engineer, 2nd grade, sub. *pro tem.*, Supernumerary, State Railways, and Superintendent of the Office of the Director-General of Railways, is promoted to the rank of Honorary Assistant Engineer.

Lieutenant-Colonel T. Howard, R.E., Executive Engineer, 1st grade, North-Western Provinces and Oudh, is granted special leave for one year, under the terms of Public Works Department letters, dated 3rd October 1887, with effect from such date as he may avail himself of it.

Major M. C. Brackenbury, R.E., is appointed *ex-officio* Deputy Director-General of Railways, with effect from the 1st April 1888, in addition to his duties as Under-Secretary to the Government of India in the Public Works Department, Railway Branch.

The following officers at present attached to the office of the Director-General of Railways are appointed Assistant Secretaries to the Government of India in the Public Works Department, with effect from 1st April 1888 :—

Mr. E. H. Stone, Executive Engineer, 2nd grade, State Railways.

Captain G. F. Wilson, R.E., Executive Engineer, 3rd grade, State Railways.

Mr. H. P. Burt, Executive Engineer, 4th grade, temporary rank State Railways.

Military Works Department.

The following promotions and reversions in the Engineer Establishment of the Military Works Department are sanctioned, with effect from the dates specified :—

Lieutenant A. L. Swainson, R.E., Assistant Engineer, 2nd grade, temporary rank, to be Assistant Engineer, 2nd grade, sub. *pro tem.*, with effect from 27th September 1887.

Captain A. L. Mein, R.E., Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 5th November 1887.

Captain T. Digby, R.E., Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 5th November 1887.

Lieutenant J. A. Gibbon, R.E., Assistant Engineer, 2nd grade, temporary, to be Assistant Engineer, 2nd grade, sub. *pro tem.*, with effect from 5th November 1887.

SALE OF IRON PADDLE STEAMER.

TENDERS for the purchase of the Madras Government Steam Tug *Madras*, built at Blackwall by T. A. Young in 1876, will be received by the Port Officer at Madras up to noon of Tuesday, the 1st May 1888.

2. The vessel will be sold at Calcutta with engines, boilers, masts, sails, awnings, spars, anchors, cables, boats, and such other stores as may be on board on the 30th March and which will not be removed previous to the sale.

3. Each tender, before being opened, must be accompanied by a treasury receipt for a sum equal to 25 per cent. of the amount offered, and the balance must be paid within 48 hours of acceptance of the tender and before delivery is taken. The tenders will be submitted to the Government of Madras for orders.

4. The vessel will be at the risk and charge of the purchaser from the date the acceptance of the tender by Government is communicated to him.

5. The following description of the vessel is believed to be correct, but any errors or misdescription shall not annul the sale, nor shall any compensation be allowed on that account:—

Tonnage	...	197 gross.
Do.	...	57 nett.
When built	...	In the year 1876.
Where built	...	At Blackwall.
Extreme length	...	123 feet 4 inches.
Do. breadth...	...	20 feet 8 inches.
Depth	...	11 feet 1 inch.
Number of bulkheads	...	Three.
Do. of decks...	...	One.
Engines	...	Two side lever disconnecting surface condensing.
Boilers	...	One multitubular.
Horse-power indicated	...	137.
Do. nominal	...	75
Coal that can be stowed in bunkers	...	66 tons.

6. The vessel will be open for inspection at Calcutta on applying for an order to the Deputy Director of India Marine on or after the 30th March 1888.

MADRAS PORT OFFICE, (H. A. STREET, CAPT.,
15th March 1888 (H. M.'s INDIAN MARINE, Port Officer.

WANTED

Two Assistant Engineers and a Supervisor for the Local Fund Public Works Department, Madura District.

Pay and travelling allowances will be as shown below.

Appointment.	Pay.	Travelling allowance.
Assistant Engineer 1st Grade	Rs. 250 per mensem rising to Rs. 300	Mileage at 4 annas a mile for rapid marches and daily al- lowance at Rs. 2 per diem
Assistant Engineer 2nd Grade	Rs. 200 per mensem rising to Rs. 250	ditto.
Supervisor	Rs. 150 per mensem rising to Rs. 200	Daily allowance at Rs. 1-8 per diem.

The increase of Rs. 50 over the minimum pay in the case of each of the above 3 officers will be allowed by five equal annual increments of Rs. 10, provided that the officer continues to give satisfaction in the discharge of his duties.

Applications should be made to the undersigned so as to reach him before the 31st March 1888, with the following particulars:—

- (1.) Name.
- (2.) Age.
- (3.) Examinations passed.
- (4.) Present occupation, if any, and previous employments held, if any.
- (5.) Copies of testimonials.
- (6.) Address.

None but those holding the College Certificate need apply.

Successful applicants will have to execute an agreement binding themselves to serve the Madura District Board, in the terms which may be specified by the President.

The applications from unsuccessful candidates will be recorded and no reply will be sent to them.

E. TURNER,
President, District Board,
MADURA.

(99)

NOTICE TO CONTRACTORS.

SEALED tenders will be received by the Chairman, Karachi Port Trust, up to noon on 11th April 1888, for supply of second-hand rails in good condition, as follows, delivered at Keamari on Port Trust ground:—

250 Metre Gauge rails, Vignoles pattern, about 40lbs. to the yard, each rail to be 18 feet long, and suitable for shed posts.

250 Broad Gauge double headed rails, about 66lbs. to the yard, each to be 18 feet long, and suitable for Railway sidings.

Price to be quoted per rail, and whether steel or iron, should be stated.

The supply to be completed within one month from the date of order.

The lowest or any tender will not necessarily be accepted.

By order,
W. H. PRICE, M. INST., C.E.

PORT ENGINEER'S OFFICE; } Port Engineer,
Manora, 12th March 1888. } (103) KARACHI.

WANTED IMMEDIATELY

ESTIMATOR for Chief Engineer's Office, C.P.
None but first-rate men need apply.

Apply, with testimonials, to—

ASSISTANT SECRETARY,
P. W. D., Nagpur, C. P.

AN ENGINEER, &c., of many years' practical experience at Home and in India is open to an engagement. Large experience in seating boilers, building, &c. Good testimonials, reference, &c.

Address—H. F. B.,
c/o "Indian Engineering,"

(84)

CALCUTTA.

For Sale.

200 WHEELS for Handbarrows, 15½" diameter, quite new. Complete with 2 brackets and 4 bolts for each.
Price, Rs. 2, each, delivered Lahore Station.

NIHAL CHAND,
Contractor,
LAHORE.

(80)

BENGAL-NAGPUR RAILWAY.

EXPERIENCED ESTIMATORS for Railway work (Bridges, Station Buildings, and Staff Quarters) wanted immediately, To report at Nagpur. Pay Rs. 65 a month.

Apply to—

G. A. ANDERSON,
FOR AGENT AND CHIEF ENGINEER,
B-N. Railway, Nagpur, C.P.

(85)

WANTED BY THE S. I. R. COMPANY.

ENGINEERS AND SURVEYORS.

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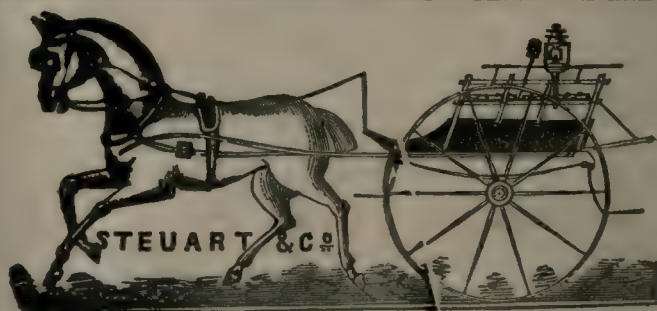
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Obituary.

BABOO GOBIND CHAND DASS, Sub-Engineer, P. W. Dept., Mohanuddy Division, Orissa, died at Calcutta on the 28th February 1888.

FALVEY.—On 21st March, at Ootacamund, Lieutenant D. Falvey, D. P. W., aged 53 years.

INDIAN ENGINEERING.

SATURDAY, APRIL 7, 1888.

THE GEOLOGICAL SURVEY OF INDIA.

PART I. of the "Records" of the Geological Survey of India for 1888, contains the Annual Report for 1887, and being the first ever presented by Dr. William King, the present "Director" of the Survey, we consider the occasion opportune, while reserving the contents for notice elsewhere, to say something on a scientific branch of the service that has now been working systematically in the country for upwards of thirty-two years.

While there have been many geological reports on various Indian districts in the years preceding the regular establishment of the Survey, it was not till 1857 that any attempt was made to collect and classify all these geological labors or summarise the results obtained by independent inquirers.

Prior to the arrival of Dr. Thomas Oldham in India, to take up the appointment of "Geological Surveyor," that office had been held successively by Mr. Williams and Dr. McClelland, and the only idea the Government then had of the duties of such an officer was that he should go about from place to place, and report on real or fancied discoveries of minerals. Hence Dr. Oldham had to face many difficulties at the outset, "to obtain a definite geological horizon from which to work up or down, and so obtain a true basis for future operations," and it was only through Lord Canning's enlightened interest in geology that he was able to commence a regular survey of the country.

In 1856 the Geological Survey was placed on a proper footing. "Dr. Oldham's staff was increased, the labors of the Survey were systematized, and the reports were ordered to be published in a uniform series."

It is impossible to go into the progress of the survey in each district or to particularise the work done by each observer. The results have been recorded in the "Memoirs" of the Survey; they are associated with the names of the Oldhams, the Medlicotts, the Blanford, Ball, and others.

In February 1876 Dr. Oldham resigned his appointment as "Superintendent" of the Survey, which he held since 1851. Before commencing his service in India he had been in the Irish Survey and Professor of Geology at Trinity College, Dublin. When he arrived in the country he found that the establishment of the Geological Survey then consisted of "one peon and one writer, with no European Assistant and preparation for field work." During the 25 years that Dr. Oldham presided over the Survey, he advanced it to its present position by his great ability, learning, and unwearied exertions. He was succeeded by Mr. Medlicott, and in August 1885 the official designation of the Head of the Department was changed to "Director." On Mr. Medlicott's retirement in April 1887 Dr. King was appointed to succeed him. The present personnel of the Survey is given on the front page of the "Records"

referred to in the opening passage of this article, and shews a new and useful departure.

The Museum of Economic Geology and the Geological Library are practical features of the Survey, which require no commendation at our hands, while the "Palæontologia Indica" has been characterized as a "superb series"—containing figures and descriptions of organic remains procured during the progress of the Survey—unrivalled as an achievement in any country.

In spite of all difficulties of climate, inaccessibility and other drawbacks, a vast area has been examined and a great work done by the members of the Survey—"animated by a noble devotion to the cause of science." The task of these Indian Geologists—observes an authority quoted by "Markham"—is neither a safe nor an easy one. "Out of the two dozen or so who have entered the Survey since it commenced 34 per cent. have been struck down by death or incapacitating disease. The rest work on zealously and bravely, reflecting honor on English administration by the results of their labors, extending the sum of human knowledge, and doing much practically useful work."

BOMBAY GRAVING DOCKS.

It is not so very long ago that Indian affairs engrossed very scant attention in the House of Commons. They were relegated to the fag end of the session, when little or no interest would be evinced in them, and if any discussion did take place it would be confined to loiterers in the House, and the speeches were generally addressed to empty benches. But within the last few years a change has come over the spirit of our legislators' dreams at St. Stephen's, and scarcely a mail comes to hand but it brings some indication on the part of Englishmen to receive more trustworthy information in regard to the brightest gem in the British diadem. We need not stop here to quote instances in support of our position; all that we need say is that among other topics the inquiries which have been lately made in the two Houses in regard to the provision for Graving Docks at Bombay shews which way the wind blows. Of course we do not expect that the public at home should take the same intelligent interest in the matter as those whom it directly concerns. The people of Bombay are greatly exercised about these docks on the principle that that which is nearest to us touches us most. But when questions of Imperial necessity are involved, such as the re-armament of distant fortresses, the defence of coaling stations, and the strengthening of British naval forces in high seas, we may rest assured that it will command more than a passing notice. There is, however, just a lingering suspicion that all is not for the best, and so far as the economical point of view is concerned, India might be compelled to submit to a sacrifice at the bidding of the Admiralty, and India is not without its lessons in the past.

As a contemporary rightly observes:—And since, whatever is done, India will have to pay for it, people at home will not be too careful that the work is carried out with economy. Considerations of economy belong to the Indian view of the question; they will not prevail unless

the India Office is more successful in influencing the Admiralty than it traditionally has been in its bargains with the War Office, for we always have to be prepared for the possibility that "My Lords" will make the Admiralty view of the question prevail over the view which the India Office, if it were always a vigilant guardian of Indian interests, would insist upon.

As an instance in point, let us cite the events associated with the visit of Sir John Coode to Bombay, a little more than two years ago, under instructions from the Home Government, to report on the scheme for a graving dock there. It is almost certain he was fettered in his actions, and he was not free to advise what his instincts as an eminent professional Engineer would suggest as best suited to the requirements of that port. This scheme, we believe, is among those which have been taken into consideration by the India Office and the Admiralty, but we doubt whether its expensive character will be a bar to its adoption. Nothing is done by halves when India has to find the costs, and the question of its necessity is not supposed to stand in the way of carrying the scheme through. For upwards of a century Bombay has managed to exist without a dock, and now when the construction of one is on the tapis it seems that the project is to be executed on the most extravagant scale imaginable, as if the ordinary work expected of it would be to accommodate iron-clads and fighting vessels of all sorts. Whereas the fact is that the dock is intended to put up ships of all sizes. There are a few objections to an over-generous outlay on this head. In the first place the undertaking is expected to cost £300,000, with an additional expenditure of a few lakhs a year to keep its approach clear of all obstructions—in other words, the process of dredging it will continually be resorted to, for the purpose of admitting war vessels of large draught.

There is another scheme the convenience of which would be confined to vessels of the mercantile marine and would be of no use to the huge monsters of the deep such as the English navy boasts of. A mean course is therefore the best, and it lies between Sir John Coode's proposal and the scheme for the enlargement of the Duncan Dock; this would cost about £180,000, without the additional charge of dredging the channel. At the same time it is a fit subject for enquiry, whether, without going to a separate expenditure on account of war vessels alone, the dock contemplated by the Port Trust would not be made to serve iron-clads which could not be housed in the Duncan Dock. As at present situated the advantages are all on the side of having the naval dry dock on the Government Dockyard property. It is true the workshops are there, and if any other site was fixed upon, there would be some difficulty in finding an eligible locality. But if this difficulty could be conquered, something might be said in favor of making provision for the mercantile marine and the navy, as one intended for the latter could not find full occupation. As a compromise a Bombay contemporary says:—"The adaptation at the cost of a few lakhs of the Duncan Dock to the requirements of vessels of the navy of smaller draught, and the con-

struction of the proposed commercial graving dock with the necessary provision for the occasional docking of an armoured cruiser of the first-class, might prove an economical compromise between two costly schemes."

Since writing the above the English mail of the 9th ultimo has come to hand. We find that the subject of a dock at Bombay was again discussed in the House of Lords. Viscount Middleton asked if it was a fact that there was not a single iron-clad on the Indian station, and what steps would be taken for the construction of a dock at Bombay. He had been given to understand that the plans for a dock had been already prepared and he hoped the report was correct. Lord Elphinstone, in reply, said that there were no iron-clads on the Indian station, because the Admiralty thought it was not necessary for the protection of British commerce; and as for the other question, the Admiralty fully recognised the necessity of having a first-class dock at Bombay, which could accommodate first-class iron-clad ships if it were necessary in time of war and that they were in communication with the India Office on the subject. Viscount Cross said that there was every reason to believe that the correspondence referred to by Lord Elphinstone would be brought to a satisfactory conclusion, when not a moment would be lost in carrying out the scheme which was absolutely necessary, not only for India, but for the protection of the commerce of the United Kingdom. Here the matter rests for the present.

PROGRESS IN THE NATIVE STATES OF SOUTHERN INDIA, 1886-87.

IN Travancore last year the operations of the Survey Department extended over 13 taluks, the coffee lands in Pirmed, the salt pans of the Southern Division, and the Travancore-Cochin boundary. Boundary demarcation was carried on in eight taluks, and completed in three. 322.25 square miles in six taluks were completed by the Field Survey Party. Insertion of topographical details in the 16-inch scale map of the remaining 85 square miles of Trivandrum taluk was completed. The gross receipts of the Forest Department amounted to Rs. 4,03,545, the expenditure to Rs. 1,79,341. A plan has been introduced of selling timber daily under the *dépôt* system, and has proved successful. Rs. 9,19,706 were expended on public works principally on improvement of principal old main irrigation channels. To the Maramut Department Rs. 2,89,324 were allotted. Rs. 26,943 were spent on tank works, Rs. 31,159 on the improvement and opening out of village roads, and Rs. 29,615 on the construction of a palace for the Maharaja. The work of the Industrial School is improving in quality and quantity. The conservancy of the capital was efficiently carried out at a cost of Rs. 19,568.

As regards Cochin we learn that the expenditure on Public Works for the year was Rs. 3,55,139-4-4; less by Rs. 9,533 than last year's outlay. The main work undertaken was road making; but besides this the Mulathurai irrigation canal was extended $2\frac{1}{2}$ miles, and proved of great value in saving crops on the point of withering. The trees

in the State teak plantations (of which there are 24) have reached an average height of 36 feet, and an average girth of 20 inches, against last year's 30 feet and 13 inches respectively.

In the Godavari Agency Rs. 11,621 were allotted for Public Works and Rs. 9,781 spent on bridle-paths and new roads. One of these runs from Gokavaram to Rekapalle, through the heart of the Rumpa country. Two others have been started, one between Chodavaram and Kota, one from Timmapuram to Ramavaram, which carries traffic from Jeypore and the Central Provinces to Eleswaram market. 13 out of 28 proposed forest reserves have been settled. Export of timber from Bhadrachalam has decreased, owing to the high rates of seigniorage demanded. We are glad to hear that the initial dissatisfaction caused by formation of the forest reserves has been judiciously mollified and has subsided.

Owing to changes of divisional officers, and absence of subordinates, as much work was not done as ought to have been done in the Vizagapatam Agency. Rs. 3,646 were spent on the Chollapadam-Rayaghada road and Rs. 1,855 on the Parvatipur-Narayanapatam road. The first is reported in excellent order, and great improvements have been made to the latter. Owing to financial pressure nothing beyond road repairs was done in the Ganjam Agency.

In the Pudukota State, the main roads to Trichinopoly and Tanjore were maintained in order, and that to Madura completed.

In Sandur, owing to the dryness of the weather before the monsoon set in, destructive fires occurred both in the leased and amani forests. The Raja bought nine ploughs of an improved type, exhibited them at work, and offered them to the ryots at half price. But the ryots proved conservative to the backbone, and none of them could be persuaded into having anything to do with improvements.

THE WORLD'S STEAMERS.—The number of steamers existing in the world last year was estimated at 9,969, of an aggregate burthen of 10,531,843 tons, and this was made up as follows: Iron steamers, 8,198, of an aggregate burthen of 8,911,406 tons; steel steamers, 770, of an aggregate burthen of 1,206,932 tons; and wooden steamers, 822, of an aggregate burthen of 380,655 tons. Of the steamers afloat in 1885, 5,792 were owned by the United Kingdom and its Colonies, the aggregate burthen being 6,695,871 tons. The other countries of the world owned last year the following steamers: Germany, 579; France, 509; Spain, 401; the United States, 400; Norway, 287; Russia, 212; Denmark, 200; Italy, 173; Holland, 152; Brazil, 141; Japan, 105; Greece and Turkey, 82 each; Belgium, 68; Chili and the Argentine Republic, 43 each; China and Portugal, 27 each; Hawaii, 21; Mexico, 15; and miscellaneous, 50.

EXHIBITIONS IN 1888.—The present year bids fair to be remembered as a year of exhibitions. In addition to the show of Jubilee gifts at the Vatican, there will be international exhibitions at Glasgow, Melbourne, Barcelona, Brussels, and Copenhagen. Munich announced a national exhibition of German industry and an international art exhibition. In honor of the completion of the fourth decade of the Emperor of Austria's reign—they are calling it a "Jubilee" in Vienna—a national exhibition of Austrian industry and an international collection of pictures, statuary, and other *objets d'art* will be opened in the capital. Genoa will hold an international exhibition of flowers and fruit, to include illustrations of the floricultural and horticultural art; and at Bologna, which boasts of being the most musical city of Italy, and was long the residence of Rossini, an international exhibition of music and musical instruments, historical, artistic, and industrial, will be held in the latter part of the year. The latter exhibition is intended to celebrate the eighth centenary of the University of Bologna. The Russian Society for the encouragement of Trade and Industry promises an exhibition of Russian textiles and machinery at Warsaw; and Berlin is inviting contributions to an international sportsman's exhibition, which is expected to be one of the attractions of the German capital about the middle of the year. In London, in addition to the usual crowd of minor exhibitions, we are to have an Italian exhibition, to which a large number of exhibits have been promised, including illustrations of Roman life in classic times, and displays of every branch of Italian fine arts, industries, national sports, and pastimes.

Notes and Comments.

VERY SIGNIFICANT.—Colonel C. A. Goodfellow, V.C., R.E., Chief Engineer for Irrigation and Officiating Superintending Engineer, C. D., Bombay, has been granted furlough for one year and four days.

THE EGYPTIAN P. W. D.—The contract between Colonel Sir Colin Moncrieff, the Under-Secretary in the Ministry of Public Works, and the Egyptian Government, expires in May next, but he will remain in the Egyptian service.

THE MADRAS LIGHT HOUSE.—The light in the Madras Light House was re-exhibited from the 1st instant. The new apparatus produces an improved light to that shewn by the old one, which had been in use for upwards of 40 years.

LARGE SALE OF TIMBER.—One of the largest sales of timber ever made in Rangoon took place the other day. Messrs. Darwood and Macgregor purchased nine thousand logs of Upper Burma teak for Rs. 60 per log. The wood is from Moungh Moon Hta's forests.

PUBLIC WORKS IN RAMPORE.—This State has secured the services of an officer of rank in the Department of Public Works, to plan and execute designs for the improvement of irrigation in the State by a system of canals, and for the better drainage and sanitation of the capital city.

A NEW P. W. D. DIVISION IN UPPER BURMA.—The Chief Commissioner has sanctioned another P. W. Division called the Kyouksi division in Upper Burma, and Mr. C. A. B. Target, Executive Engineer, 1st grade, has been placed in charge of it. It is understood this is an Irrigation Division.

BENGAL-NAGPUR RAILWAY.—The Board of Directors of the Bengal-Nagpur Railway Company, Limited, invite tenders for triangulated girder bridges, 100ft. span, and plate girder bridges, 80ft. span. These "proposals" enable us to form an idea of the class of structures that will be adopted on the line.

A SUBMARINE CABLE FROM JAPAN TO AMERICA.—According to experts, a submarine cable from San Francisco to Yokohama can be laid at a cost of from \$1,200 to \$1,500 per English mile. The very highest standard of efficiency could be obtained for an expenditure of \$2,000, but for all practical purposes a first-class cable could be laid for \$1,500.

BRITISH NORTH BORNEO.—Fowler's narrow gauge Railway, 30 inches gauge, is now being used at Sandakan for use in reclaiming a portion of the town immediately below the Government Offices. This portion of the town is still unsold, and it is hoped that the price when realized will repay the expenditure; should this be the case further reclamation will probably follow.

THE "OTHER" SERVICES.—The Public Service Commission think, that in the present state of scientific education in India, it is unable to recommend any change in the system of recruitment for the Meteorological Department. Also that the rule which prescribes that Commissioned officers only shall ordinarily be appointed to gazetted offices in the Assay Department of the Mint should be cancelled.

THE INDUS BRIDGE AT SUKKUR.—We hear from a correspondent in the North-West that progress is at last being made with the Bridge over the Indus at Sukkur, the first triangle of the cantilever having been complet-

ed. Some idea of the size of this bridge may be formed from the fact, that the lengths of the members of this first bay are 210', 169', and 123', so that each of them is quite a respectable bridge in itself.

LYLE'S SIGNAL WIRE PATENT CARRIER.—We are informed that several of the leading Railway officials in various parts of India have examined and tested the working of these patent carriers. The recorded opinion is, that there is no doubt but that these carriers will entirely do away with the old system of carrying the wire on stumps. The cost of Lyle's Carriers is two-thirds less than the cost of the old stake system.

BARUR TANK "B" PROJECT, SALEM.—This work was commenced as a relief work during the last famine. The project provides for an anicut across the Poniar river, supply channel to Barur tank, enlargement of the tank and its irrigation channels and for head-slucices to existing channels. Revised estimates for this project were sanctioned by the Secretary of State in February 1886, to the extent of 4 lakhs of rupees, of which nearly 3 lakhs had been expended up to 1886-87.

COKE ADULTERATION.—The Manager of the Calcutta Gas Works states that up-country coke, produced from the dross, dust of the pits, the dross of coal, and lastly unsaleable inferior coal, being gathered in large heaps, then half burned, and afterwards drenched with water, making a kind of impure coke, has been palmed off as gas coke by unscrupulous dealers in collusion with disingenuous servants. We suspect, however, that this interested assertion is open to question and susceptible of considerable modification.

THE CHIEF ENGINEERSHIP OF BURMA.—It is rumored that Colonel W. G. Cumming, R.E., is likely to be the first Chief Engineer of the amalgamated provinces of Upper and Lower Burma. No better selection could be made, as this officer has passed the most of his Public Works Department service in that Province, and is better acquainted with its requirements than any Engineer of his grade now in India. This post was offered to Mr. E. J. Martin, the Senior Superintending Engineer in Bengal, but refused in expectation of obtaining something better.

THE DELAGOA RAILWAY.—Lord Rosebery, in the House, referring to the danger of the Delagoa Railway falling into the hands of an unfriendly Power, asked the intentions of Government. Mr. Onslow replied, that it would be an unprecedented act for the Imperial Government to purchase a railway on foreign territory. He thought that the Natal or Cape Colony might purchase it. At any rate both, being out of long-clothes, were able to look after their own interests. The reply elicited criticism outside, since it is denied that the Cape intends to purchase it.

THE LUCKNOW BORING.—Up to last week the artesian well has been sunk 58 feet. The work is said to be in charge of a gentleman from Connecticut, who has been engaged in this sort of thing from his 17th year, in all the States; so we are informed that "if, at the end of the 800 feet to which extent the boring is to go, water is not reached, it will be simply because there is none at that depth." But unfortunately for the undertaking, owing to an accident to Mr. Tunbridge, the American gentleman who is in charge of the works, the works at the Lucknow Artesian well are now at a standstill.

THE OXUS BRIDGE.—The official report on the structural value of the bridge is that the Engineer Balinski and General Annenkoff have achieved a wonder-

ful success. At first the idea of building a wooden bridge over the Oxus was considered an exceedingly risky one, for on account of frequent floods the river is always overflowing its banks and changing its bed. It appears, however, that the bridge has been so designed as to run no danger under this head; and it only remains to keep up a provisional service of trains till the wooden bridge is replaced, as it will be by one of stone.

KIDDERPORE DOCK-WORKS.—It is a satisfactory feature in large public undertakings, when those responsible for their execution invite inspection on the part of those qualified to judge of the nature of the works in progress, and pronounce on their merits or otherwise. The Kidderpore Dock-Works have now arrived at an important stage, and the Engineer-in-Charge proposes to shew a few gentlemen round on Saturday morning, the 7th April. Some representatives of the Profession have also been invited to join the party, and we have no doubt that the visit will be fraught with instruction and interest.

AN ITEM FROM BURMA.—The Government of Bengal are anxious to transfer some of their Upper Subordinates to Burma, and it is very unlikely they will give up their best men, for when reductions are to be effected in an establishment, the most inefficient and rubbishy lot are generally elected. Besides this arrangement would be very rough on those temporary Upper Subordinates now employed in Upper Burma, who have done good service since its occupation, and naturally look forward for permanent employment. It is cheaper policy to retire inefficient and useless men than to foist them on a Government like Burma, which really requires the most active and most efficient subordinates possessing ready resource.

GANJAM-GOPALPUR CANAL: "A" PROJECT.—This canal will be a continuation of the one from the Chilka lake to Ganjam which was originally constructed as a famine relief work. The port of Ganjam, which was once important, was subsequently, owing to its unhealthiness, superseded by Gopalpur 12 miles to the south. The continuation of the canal is therefore considered necessary. Estimates for this work amounting to Rs. 4,31,000 were sanctioned by the Government of India in April 1885. The Secretary of State remarked that, as the ultimate return is only little more than $1\frac{1}{2}$ per cent. on the estimated capital outlay, and as it is not proposed to commence the project until the completion of the Rushikulya project, a decision on the project might be postponed for the present.

BOMBAY MUNICIPALITY: A CONSULTING ENGINEER WANTED.—Somebody asks: I should like to know what arrangements are there for thorough inspection by a competent Engineer, and since the death of the Consulting Engineer of the Corporation, what steps have been taken to replace him. A sanitary expert informs me that the present method of laying the drainage pipes is certain to pollute the soil, and be the fruitful source of future disease. It would be interesting to know who is answerable for the pretty state of the Kennedy Sea Face. It would be interesting to know who is answerable for the wretched state of the roads. The experiment of one man—the so-called "Municipal Commissioner"—attempting to supervise the whole executive work of a great city, has not proved an entire success.

THE MANILA RAILWAY COMPANY, LIMITED.—The Hong-Kong and Shanghai Banking Corporation invite subscriptions for the issue of the whole of the capital

of the Manila Railway. The Company is formed to take over the concession for the construction and working of a railway, starting from the port of Manila, Island of Luzon, and terminating at the port of Dagupan, on the Bay of Lingayen. The length of the railway will be about 120 miles. A guarantee of 8 per cent. on a capital of \$4,964,400 has been granted by the Spanish Government for a period of 99 years, payable out of the Treasury of the Philippine Islands. The concession is for the term of 99 years from its date, namely, the 9th April, 1887; on the expiration of which term the railway and rolling-stock revert to the State without compensation.

USEFUL INFORMATION FOR ENGINEERS.—We have received from Messrs. T. Cosser and Co., of Kurrachee, a Section Sheet of Rolled Joists, illustrated, giving the weight (distributed) on various clear spans, also the same printed on vellum and folding into a small book cover like a Railway map. The former is intended for office use and to be pasted or put in a frame like a picture and hung on the wall. The latter is for an Engineer's personal use, and is of a very convenient size, going in a pocket, and being flat and compact it does not bulge out the pockets of a person's coat. They are issued *gratis* to the firm's constituents, and we think that they will be of great use to Engineers generally. They are, to the best of our belief, a long way ahead of anything hitherto made of the same kind by any firm or individuals in India.

LOCAL INDUSTRIES IN MYSORE.—This Native State annually produces cotton fabrics to the value of nearly 20 lakhs of rupees, besides woollen, silk and other fabrics. Tape for bedding, carpets, tent cloth, articles of apparel, and coarse cloths are manufactured from Mysore cotton. The elegant cloths worn by females, and their pretty jackets, are woven of cotton mixed with silk thread, and the Mysore patterns are generally appreciated by the neighbouring districts in Madras. But recently, says the *Bangalore Spectator*, the pretty patterns of Hubli, Dharwar, and other places on the West have been largely imported, and since the opening of the Southern Mahratta Railway beyond Bellary, merchants come to Bangalore, where the demand for the stuffs manufactured in those places is great, and increasing, both on account of the elegance and the novelty of the cloths.

COLOMBO VERSUS TRINCOMALIE.—The Lords of the Admiralty distinctly stated that they would aid in the construction of a Graving Dock last year, and the offer of the Colombo Chamber of Commerce that if the Home Government would build the Dock they would urge the local Government to make the Northern Arm, and maintain the Dock in repair, is considered a liberal concession. It would of course be useless for the Admiralty to build a Graving Dock in Colombo if Trincomalie were still kept up as the naval head-quarters for the Eastern Squadron, and the many natural advantages of the eastern port in that respect have doubtless proved too strong in its favor for its abandonment. But, if the Admiralty build a Graving Dock there, instead of at Colombo, they will not only have to bear the whole expense themselves, but will also have to maintain the Dock at considerable cost.

SANGAM ANICUT, NELLORE.—The Sangam anicut, which is about 20 miles above the Penner anicut, is intended to irrigate 94,000 acres on the north of the Penner, the southern portion being irrigated by the Penner anicut at Nellore. The supply in the river being intermittent, water is stored in two large reservoirs known

as the Kanigiri and Duvur reservoirs. The net return anticipated is 5.26 per cent. on the estimated capital outlay. This project, which was sanctioned by the Secretary of State in February 1881, is nearing completion. The amount sanctioned having been found insufficient to complete the project, revised estimates, amounting to Rs. 30 lakhs, were submitted to the Government of India on the 1st July 1887, but sanction to these estimates has been deferred pending submission of revised forecast statements of revenue and expenditure.

MORE DOCKS FOR BOMBAY.—We learn that Mr. James Bowack has at length obtained the sanction of the Port Trustees to his proposal to construct two graving docks in Bombay harbor. The site originally chosen for the docks by Mr. Bowack was disapproved by the Harbor Defence Committee, on the ground that it was in the probable line of fire of a hostile ship-of-war entering the port. Mr. Bowack accordingly made a fresh selection. His choice this time has fallen on a position to the north of Butcher's Island, which has been leased to him by the Port Trustees. Mr. Bowack left Bombay for England this week, in order to secure the support of ship-owners and others in floating his project as a limited liability company. There is great want of graving docks in Bombay, for at present it cannot be said that there are any facilities at all for repairing private vessels that may have been injured on the voyage out.

MANUFACTURE OF IRON IN THAYETMYO.—Iron ore exists in large quantities in many parts of Upper Burma, especially about Sagaing, and the natives in Thayetmyo collect the ore and convert it into iron in a very simple furnace which is constructed on the slope of a river bank, and is very easily made. Abundance of charcoal for smelting can be obtained in the neighbouring forests without any expense, and in order to encourage the business diagrams of the furnace with full instructions for working it are published in the last *Burma Gazette*. Of late years the importation of iron has checked the business, but at one time during the reign of Mind on Nin, the last King of Burma, one village alone used to present him every year with 50,000 viss of iron as tribute, the iron being valued at ten rupees per 100 viss. The iron is said to be much better than that imported for making cleavers and *daos*, and is chiefly used in this shape by the Cutch boilers for cutting wood.

LORD CONNEMARA ON RAILWAY LOCATION.—The Governor of Madras recently declared that that Presidency is suffering from the mistakes of predecessors long gone by. Those who made the alignment of the Madras Railway seem to have taken the precaution of avoiding all the populous centres as much as possible, and to have imagined that the line would pay better by passing through jungles instead of through towns. There can be no doubt that with respect to Salem, Vellore, and other places, they would have done better had they not kept the railway four or five miles from the town, and the difficulties are very great in consequence. It is a most anomalous thing to see a town of 60,000 people like Salem, where the railway is about five or six miles away from the town, and no railway running into its midst. The mistake, however, we may add, has not been confined to the Madras Railway. There are other lines in the country displaying the same want of commonsense in their alignment.

A FAMILY AFFAIR.—The *Morning Post* says:—Colonel Jenkins, the Agent of the O. and R. Railway, retires from the end of the month. He succeeded his

brother-in-law, Colonel Beadle, fifteen years ago, the latter since that period having been a member of the Board of the Company at home. Mr. Hartwell, Colonel Jenkins' son-in-law, takes the Agency and Traffic Management temporarily till the expiration of the contract at the end of this year. Colonel Jenkins, if not always acting in harmony with the Government or the wishes of the public, has at least conducted the affairs of the Company in a painstaking and conscientious manner. If the employes have felt that in Colonel Jenkins they had a kind and just protector, they have been able also to make allowances for any shortcomings from the position the line has drifted into, as regards the family system which, with the exception of the Engineering Branch, pervades all the most important posts of the other departments.

A GRAVING DOCK FOR BOMBAY.—The Bombay Port Trust have called upon their Engineer to prepare plans and estimates for a dock 550 feet long and 26 feet on the sill to cost Rs. 12,53,000. The alternative estimates of cost of a graving dock are.—

Dock 550' long and 23' deep on sill	...	Rs. 11,55,000
" " " 24' " "	...	" 11,88,000
" " " 25' " "	...	" 12,20,000

The Engineer states that he has no borings on the line of the proposed dock, and that the nature of the bottom will, of course, affect the estimates, but that so far as he can judge, nothing is likely to be found which will affect the comparison to a serious extent. The Engineer further states that the question of extra pumping is not a serious item, as it resolves itself into keeping the pumps going a little longer, and that this is not a heavy charge when steam is up. The Engineer adds that he has assumed the floor of the dock to be 2 feet lower than the sill, and that if it is thought desirable to have the floor lower than this, each foot will cost about Rs. 25,000.

CANAL EXTENSION.—Schemes are under the consideration of Government for the construction of three canals at a cost of about Rs. 2,00,000, all to draw from the Ravi above the Sidhnai Canal; one to irrigate the Doab on the right bank of the Ravi between it and the Chenab, the two others to irrigate land on the left bank of the Ravi, which could not be provided for from the Sidhnai Canal owing to the high ground. When these works have been constructed, the total area commanded by the Sidhnai Canal will be 527 square miles, and the total cost of construction will not exceed ten lakhs of rupees. The total area which may be expected to be irrigated annually from the complete Sidhnai Canal system is 135,000 acres, which, under the present rates, Rs. 2-8 and Rs. 2-4 per acre for kharif and rabi crops, respectively, will give a gross revenue of about Rs. 3,18,000. Deducting maintenance and working expenses at 8 annas per acre, this will leave a net revenue of Rs. 2,50,500, shewing a profit of 25 per cent. on the capital outlay of ten lakhs.

COAL-MINING IN THE PUNJAB.—Dundot is situated on a high plateau of the Salt Range Hills and overlies the coal seam, which shews out on an average of 2 feet and extends for a good distance, and has been computed to contain four million tons of workable coal. There are two workings at present supposed to be on the same seam. One working is over a mile distant from the other. Up to July 1887 300 tons a month were turned out, and since then 1,000 to 1,200 tons a month are supplied to the North-Western Railway, principally for use on what is called the Rawalpindi section. The workings already

run 1,000 feet into the hill, but progress is at present much hampered for want of machinery, which is, however, on its way out from England. One great difficulty is that of transport from the pit's mouth to the railway station at Kalapani. The outlay on the colliery works at present has been four lakh of rupees, while the credits per contra for coal supplied during the last 12 months is not less than one lakh of rupees, so that the undertaking is an exceedingly profitable one.

PUBLIC BUILDINGS ON FIRE-PROOF PRINCIPLES.—The final report of the authorities to whom was entrusted the inquiry into the origin and effect of the disastrous fire which occurred in the Secretariat building at Allahabad on the night of the 5th November 1887 has been reviewed by the Provincial Government. The Committee was composed of officers of the Public Works Department and made many recommendations regarding improvements in the construction of public buildings. The following instructions are placed on record to be adhered to as far as possible in the future in the construction of all buildings which are intended to contain public records: (1) the flooring throughout the building should be of concrete, brick-on-edge, or flagged; (2) no ceiling-cloth or wooden ceiling-boards should be allowed; (3) outer doors which give access to passages, corridors, or staircases should be of grated iron; and every door opening on a passage should be fitted with a glazed or perforated panel, to allow the interior of the room to be seen; (4) record-rooms should be cut off from the rest of the building by solid masonry walls; and in their construction the following further precautions should be adopted: (a) all joists and beams should be of iron; (b) no wood whatever should be allowed in the roofing, which should be constructed of iron girders or arched brickwork and concrete terrace; (c) the door-frames should be of angle-iron and the doors of perforated sheet-iron; (d) all racks should be of angle-iron.

PERIYAR PROJECT, MADRAS.—From the Inspection Notes by the Chief Engineer for Irrigation, on the Periyar Project, Madras District, we gather that steady progress has been made on the work. Temporary shelter has been erected for the establishment, coolies, &c., both at Trickady, the site of the head of the tunnel, and at the Periyar. A fair road has been made from the ghat to Trickady and a good path on to the Periyar. A good beginning has been made on the cutting at the head of the tunnel, and some rock has been exposed and a little blasting done; much of the earth was removed by means of water, but as the supply in the stream is and will be much decreased, there will not be much more done in this way this season. The line for the wire tramway has been marked out, and Colonel Pennycuik purposes to extend this line from the foot of the ghat to the limestone quarries. At the Periyar, the site of the dam, a beginning has been made in the excavation on the right side of the river for the foundations of the dam on the hill side; as yet only boulders of rock have been met with. At the site of the escape a good deal of earthwork has been done and the rock exposed; this will be blasted and used on the buildings, &c. There are now about 1,200 coolies on the work. In Colonel Pennycuik's original report he proposed to construct a road and employ traction engines from the end of the wire tramway to the Periyar to convey the limestone, stores, &c. He now, on further consideration, proposes to adopt water carriage, and by means of a series of dams with locks to canalise the Muliapanjum.

Current News.

LIEUTENANT G. H. L. B. SIMMONS, R.E., proceeds to Karachi for submarine mining duty.

MR. W. R. S. JONES, Carriage and Wagon Superintendent, S. M. Railway, has been allowed one year's furlough.

CAPTAIN HOSKYN, R.E., succeeds to the Examiner-ship, Midland Railway Accounts, on Mr. W. F. Barrow taking furlough to England.

COLONEL JENKINS, Manager of the Oudh and Rohilkhand Railway, retired from the service last week. Mr. Sydney Hartwell succeeded him.

THE decrease in goods traffic on the B. B. and C. I. Railway for the week ending 3rd March 1888, was 149,106 maunds, and in money Rs. 11,433.

THE break that was caused in the East India Railway Loop line below Tinpahar last week, by the derailment of a goods train, has been fully repaired.

THREE native workmen were killed, and six more injured, by the fall of a piece of scaffolding at the Betwa Bridge Works, near Jhansi, on the 27th March.

A VALUABLE report on certain Indian fibres, which were experimented with at the late Colonial and Indian Exhibition, has just been sent to India by the Secretary of State.

AN officer of the Railway Department will shortly be selected to assist the Secretary to the Mobilisation Committee in working out any railway schemes which may be necessary.

MR. H. F. BLANFORD, Meteorological Reporter to the Government of India, at present on furlough in England, has just been granted an extension of three months' leave prior to retirement.

THE placing of the Traffic Manager of the East Indian Railway and his staff at Jamalpur, instead of at Calcutta, has attracted renewed attention since the recent affair of the wheat trade regulation.

THE transfer of the Patents Office from the Home to the Revenue Department is, we believe, at present under consideration. The Patents Office continues to remain at Calcutta for this year at any rate.

THE Indus is rising rapidly, and the tressle-bridge near Dera Ghazi Khan will be dismantled almost immediately in anticipation of the floods. The usual hot weather high winds have also commenced.

BHAMO is becoming a frontier position of some strength. Two forts on a large scale are nearly completed, and a third one not so large is in progress. The largest—Fort C—will accommodate two thousand men.

MR. J. R. BELL has arrived at Multan to commence operations on the Chenab Bridge. Nothing can be done except maturing plans, collecting plant and burning bricks, till the cold weather, when the real work will commence.

A COMMENCEMENT is being made at once with the road from Assam to Burma, discovered by the exploring party under Captain St. John Michell; and it is hoped that troops will be able to use it by the beginning of next cold weather.

THE Viceroy paid a visit of inspection to the northern portion of Calcutta to satisfy himself as to the sanitary condition of this part of the city. He was accompanied by Sir Henry Harrison and several other officers of the Municipality.

A SERIOUS accident is said to have occurred on the Bengal-Nagpur Railway between Darekassa and Salekassa. It appears that two goods trains came into collision between those stations, and the second guard of one of them was killed and about twenty wagons derailed.

THE Alexandra Bridge, which is on the Pindi side of Wazirabad station, N.-W. Railway, caught fire on Saturday week last. Fortunately it was soon discovered, otherwise a most terrible disaster might have happened; however, only a little of the wood-work was destroyed.

DURING the absence of the Governor-General in Council from the Presidency, the Honorary Assistant Secretary in charge of the Military Department of the Government of India, will have charge of that portion of the Government of India, Public Works Department, which is left at the Presidency.

IT is in the contemplation of Government to extend the line from Tarkessur 60 miles on the other side of the Damooda, in the Sub-division of Jehanabad. The two lines will be joined by a bridge over the Damooda at a place called Ramnagore. The extension line will go far beyond the courts at Jehanabad.

IT is stated that Sir Asman Jah will take advantage of Sir Charles Elliott's visit to Hyderabad to consult him regarding the proposed railway extension to Raipur. It is believed that the Minister is in favor of the project, except as regards extending the guarantee beyond the bounds of His Highness' dominions.

COLONEL LINDSAY, R.E., the Chief Engineer and Agent of the Southern Maharatta Railway Company, has been inspecting the different lines and works on the system, and is none the worse

for the sudden attack of rheumatism which affected his right arm and foot when travelling in the Madras and Mysore Districts during the cold weather.

NINE Indian artisans for the Glasgow International Exhibition left Calcutta on the 27th March in the steamer *Glan Matheson*. Two are Punjabis, and seven Bengali Hindus. Among them are two wood carvers, two jewellers, two potters, two Brahmin sweetmeat makers, and one barber. All the exhibits for the Exhibition have now been despatched.

A GERMAN invention of considerable importance to rice millers is being perfected at Rangoon. By its means rice will be polished economically by electricity, and the present costly buildings and machinery rendered unnecessary. The inventors think that their process will be as important to the trade as the utilisation of paddy-husk as fuel proved some 12 years ago.

THE Mandalay Town embankment, which it will perhaps be remembered was much injured by heavy floods about the middle of 1886, has now been put into a thorough state of repair at a cost of over four and a quarter lakhs of rupees. The greater portion of the expenditure has been incurred in constructing a new town embankment, and new bunds and sluices at Amarapura.

SIR CHARLES ELLIOTT and Colonel Conway Gordon had a narrow escape last Thursday while travelling over the Bengal and Nagpur Branch Railway. A rail had been removed by some budmashes on Wednesday night, and the goods train which just preceded that conveying Sir Charles Elliott and Colonel Conway Gordon was derailed, nine wagons being smashed.

THE case against the native driver and the others concerned in the late accident on the loop line of the East Indian Railway was heard on the 26th instant by the Sub-Divisional Officer, Rajmahal, who has sentenced the driver to undergo six months' rigorous imprisonment, his fireman has been fined Rs. 24, the guard is fined Rs. 250 and the platelayer a nominal fine of Re. 1. It is probable that the driver and guard will appeal against this punishment.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

ON THE APPLICATION OF THE MAXIMUM FLOOD SECTION FORMULA TO SMALL AREAS.

SIR,—At Mr. Craig's request I enclose a copy of his note "On the Application of Maximum Flood Section Formula to Small Areas."

Please publish Mr. Craig's note in *INDIAN ENGINEERING* if you have room.

This note is to be read in connection with "Discharge from Catchment Areas" by the same author, originally printed in *Pros. Ins. Civil Engineers*, Vol. LXXX, June, 1885, Paper Nos. 2047 and 2058; and reprinted as No. LXXX, Vol. III, No. 11, November, 1885, *Professional Papers on Indian Engineering*, third series.

BOLARUM; March 22, 1888.

G. K. WATTS.

The indiscriminate use of the formula to areas, the lengths of which are less than 2.718 (or e) miles is apt to lead to unsatisfactory results, and some explanation is necessary for the information of those who have not closely studied the problem.

It will be observed that within the limits specified for any particular value of L there is a certain value of B which will produce a maximum result, any increase, as well as diminution, in the value of B , leading to a smaller sectional area; this circumstance is more particularly noticeable for values of L less than unity as values of $L = 1$ to e (when the required values of B to produce a maximum result is infinity). The values of B are very large compared with those of L and need not be considered, as such proportions are very seldom on the plans of natural river basins, and it is the object of this note to shew how these values may be obtained in all cases, as it is only maximum results that we are concerned with at present.

The flood formula in its original shape being

$$L \left(L + \sqrt{L^2 + \frac{B^2}{16}} \right) = \frac{B}{4}$$

Flood section in feet = $80 \times B \log_e$

$$\text{We may express it thus} = \log_e \left\{ \frac{L \left(L + \sqrt{L^2 + \frac{B^2}{16}} \right)}{\frac{B}{4}} \right\} 80 B$$

We may further modify it by representing the fraction within brackets by x and the index by $\frac{1}{x}$ so that the expression will be

$$\text{Section} = P \log_e x^{\frac{1}{x}}$$

When the expression $x^{\frac{1}{x}}$ becomes a maximum, $x = e$, the base of the hyp. log.; therefore when the formula attains a maximum value

$$L \left(L + \sqrt{L^2 + \frac{B^2}{16}} \right) = B$$

and the required value of B with any given value of L to reach the maximum limit can be determined from the equation

$$B = \frac{8eL^2}{e^2 - L^2} \quad (A)$$

The formula under the maximum condition will then be

$$\text{Section} = P \log_e \frac{1}{e}$$

But $P = 80 B$, and the value of $\log_e \frac{1}{e} = \frac{1}{e}$ and the value of the whole expression is

$$\text{Section} = 80 B.$$

The value of B being obtained from the equation (A) above.

Values of B for maximum results are given below by way of example:—

		Sectional areas.	
		Square feet.	
$L = .1$	B for maximum—	.0294	...
$L = .2$	B do	.1183	...
$L = .3$	B do	.2681	...
$L = .4$	B do	.4813	...
$L = .5$	B do	.7615	...
$L = .6$	B do	1.113	...
$L = .7$	B do	1.544	...
$L = .8$	B do	2.062	...
$L = .9$	B do	2.632	...
$L = 1$	B do	3.403	...
$L = 2$	B do	25.66	...
$L = 2.718$	B do	= infinity.	...

When any dimensions of an area are given therefrom in which L is less than 2.718 miles if B is greater than the values given in the table for the particular length, the tabular values are to be used as giving the maximum possible result from the area, and not the actual value of B as measured. For example, if in any particular area the dimensions are $L = .5$, $B = 2.5$, the value of B to be adopted is .7615 and not 2.5; but if $L = .5$ and $B = .5$, these dimensions are to be used in the original formula in the usual way, the maximum of the area not having been reached.

By way of still further illustrating the principle two examples of areas are given, the dimensions of which are not given in the table:—

(1) Required the maximum flood section of an area, the dimensions of which are

$$L = .175 \text{ miles and } B = .5 \text{ miles}$$

$$\text{Maximum } B \text{ to } L = .175 = \frac{8 \times e \times .175^2}{e^2 - .175^2} = .095 \text{ Miles.}$$

which is less than B as measured, and must therefore be used to give the maximum possible result.

Thus maximum section = $80 \times .095 = 7.6$ square feet.

(2) Required the maximum flood section of an area, the dimensions of which are

$$L = .26 \text{ miles and } B = .1 \text{ mile}$$

$$\text{Maximum } B \text{ to } L = .26 = \frac{8 \times e \times .26^2}{e^2 - .26^2} = .2$$

which exceeds B as measured, so that the maximum has not been reached and the value of B as measured must therefore be used in the ordinary formula.

$$\begin{aligned} \text{Section} &= 80 \times .1 \log_e \frac{.26 \left(.26 + \sqrt{.26^2 + \frac{.1^2}{16}} \right)}{\frac{.1}{4}} \\ &= 80 \times .1 \times 1.69 \\ &= 13.52 \text{ square feet.} \end{aligned}$$

JAMES CRAIG, M.I.C.E.

"A CAPITAL SPEECH AND ITS SUGGESTIONS."

SIR,—Referring to your remarks on Technical Education in your issue of the 24th March, in connection with the Vice-Chancellor's Address at the Bombay University, the friends of M. Joubert and others may say that Government has done what it could, does do what it can in this direction by its patronage of Industrial Exhibitions. The answer is that these are spasmodic, sensational, temporary, and—trumpety. Gilt and gingerbread *tamashas* of no more economic worth, having no more abiding, not much more useful effect, than Jubilee fireworks. On the real development of industrial art, on the future of manufactures, they have, and they can have, but little effect. What is wanted is a permanent, an always abiding exemplar and teacher. Something after the manner of the *Conservatoire des Arts et Metiers* at Paris, with its instructional exhibits and its professorial staff. Much patient teaching of eye and ear and understanding is needful, such teaching as properly conducted technical institutes could afford. Our so-called Economic Museums are, for the most part musty, dry-as-dust inutilities, and in no sort meet the requirements of

PROGRESS.

Literary Notices.

THE ELASTICITY AND RESISTANCE OF THE MATERIALS OF ENGINEERING. By Wm. H. Burr, C.E., formerly Professor of National and Technical Mechanics at the Rensselaer Polytechnic Institute. Second Edition. New York : John Wiley and Sons. 1888.

THE present year is only just in its infancy and we have already to chronicle the advent of a new Engineering work. This is particularly welcome, as for the last two years there has been an almost entire cessation in the production of Engineering literature in the English language, and besides, most of the existing professional books consist of reprints of old works, which in the continual advance of constructive science are left far behind the proper standard.

The volume before us will, in our opinion, fill a very considerable gap, and from its great superiority, relegate other works on the same subject to the limbo of the forgotten past. In fact, we can confidently predict for the work a very high place in the *niche* of fame, and that it will be considered by the profession on both sides of the Atlantic as a text-book and classic for many years to come.

The work is divided into two distinct parts, which are termed "Rational" and "Technical." Rational must be a newly coined American term which we should translate into ordinarily accepted English phraseology as *Theoretical*.

The author in his very well written preface is quite apologetic, and as we think most unnecessarily so regarding Part I. We cannot do better than quote his own words on the subject, which are full of pregnant meaning.

"The first or 'Rational' part of this work is intended to furnish an analytical or rational basis for the 'Technical' or practical development contained in Part II. It will undoubtedly impress a great number, and perhaps all Engineers in active practice, that it is unnecessary to the proper treatment of such a subject. Indeed, a very considerably extended experience in iron and steel constructions places the author himself in position to fully appreciate the height of such a criticism at the first glance. But it may be contended, and he thinks must be admitted, that the present advanced state of Engineering as a profession implies the existence of something that may be called the 'Natural Philosophy' of Engineering. In other words, the Engineer of the present time must meet the increased and increasing demands upon him in some one or more speciality, not only by the aid of sound commonsense and a well trained judgment, but also by a systematic knowledge of so much of natural philosophy as is involved in practical Engineering operations." Passing over the next half page our author continues, "An Engineer's preparation for active practice must consist both of that philosophical training in what is largely ideal and which he acquires in the technical school, and of the purely practical training of the first few years of his professional life.

"The first or 'Rational' part of this work is then designed for few others than technical students, although there are Engineers, whose tastes induce, or circumstances require, investigations in connection with the elasticity and resistance of materials. The writer would esteem himself fortunate if the mathematical portion should find favor with such individuals and be useful to them." We thoroughly agree with these sentiments; a work of this description would be lamentably incomplete without the theoretical investigations. The days are past now, or nearly past, in which practical Engineers worked more or less by rule-of-thumb and regarded "theory" with distrust and contempt. We have mended our ways in this particular, and although as a *general* rule the rank and file of English and American Engineers are indubitably inferior in scientific acquirements to our neighbours in France, Germany and Italy, still the growing generation is now fully alive to the necessity of a thorough knowledge of mathematical theory, as well as of practise in the *technique* of the profession. Witness the

numerous Civil Engineering Colleges that are springing up everywhere which were unknown in the old days.

The advantage of dividing the work off into two parts is that one can take up the "Rational" part or leave it alone as he likes; and we agree with our author that most readers will leave it alone as it looks uncommonly stiff reading.

Part II. is most ably treated, and in our opinion is far superior in arrangement, style and matter to anything we have hitherto seen. Everything is set forth in the clearest manner possible, and the results of the various experiments made on the strength of different materials are abstracted, condensed, and tabulated, so as to be immediately available for use. There is no necessity for hunting about the volume to find what one requires, as is the case with other works we know of on the same subject. Everything is as clearly set down as possible.

The 1st Chapter deals with Tension in Wrought Iron, Cast Iron, Steel, Copper, Alloyed Metals, Cement and Brick, and lastly Timber. The second with the same materials under compression, with Bricks and Brick Piers. The 3rd Chapter of Part II., or the 7th of the whole volume, deals with the compression of long columns. It commences with examples of the moments of inertia worked out for pillars of every conceivable shape, either made beams or solid rolled. The information given on this point is most exhaustive. Then the several formulæ are given, some of which are quite new. The list of "Formulæ for Engineering Practise" is most valuable, as we at once obtain applications of Gordon's formula, the co-efficient varying with each section of steel or of iron. Chapter VIII. is on Shearing and Torsion. Chapter IX. is on "Bending or Flexure," or as it is usually termed with us Transverse Stress.

First flexure of solid beams is treated of all shapes and materials Rolled iron and steel I beams, (which the author writes as "eye" beams) are treated on in the fullest manner, such as we have never seen before. Then the flexure of built beams is considered. Chapter X. deals with Connections; Chapter XI. Miscellaneous Problems; XII. Working Stresses and Safety Factors; and Chapter XIII., the last, is on the Fatigue of Metals.

We can confidently state that this work is far and away the best of any on this subject in the English language, and being quite *recent* it embodies all the *latest* information and will be invaluable to the profession. We would strongly recommend everyone to get it, and would further suggest that it be used as a text-book in the Government Engineering Colleges of this country. The American publishers have avoided the error of inconvenient shape and size of volume which disfigure some English publications,—witness "Rankine" with its squat fat shape and loud red cover, about as unsuitable a size for a sober work of reference as well can be imagined. Box's *Strength of Materials* has the same fault, and is besides very confused in arrangement. This latter is now completely cut out by the admirable Yankee book we have been noticing.

New Books and Reprints.

ASTRONOMY AND METEOROLOGY.

- ASTRONOMY for Amateurs : A Practical Manual of Scientific Research in all Latitudes, Adapted to the Powers of Moderate Instruments. Edit. by John A. Westwood Oliver, with the Assistance of T. W. Blackhouse, S. W. Burnham and others. Post 8vo, pp. 312, Longmans ... 7/6
BALL (R. S.) Story of the Heavens. 3rd ed, 8vo, Cassell, ... 31/6
LANGLEY (S. P.) The New Astronomy. Illust, 8vo, Boston ... 25/

ELECTRICITY AND MAGNETISM.

- BOTTONE, (S. R.) Electrical Instrument Making for Amateurs. With 59 Illusts. 8vo. Whittaker and Co. ... 3/
TREGLOHAN, (Thos. F.) Voltaic Electricity. 12mo. sd. pp. 132 Longmans ... 1/2

GEOLOGY, MINERALOGY, MINING.

- DAVIES (D. C.) A Treatise on Earthy and other Minerals and Mining 2nd ed. Post 8vo. pp. 346 Crosby Lockwood ... 12/6

MATHEMATICS.

- CARROLL (J.) Practical Geometry for Art Students. 8th ed, 12mo, sd., pp. 95. Burns and Oats ... 1/
DALTON (Rev. T.) Exercises in Arithmetic. (Eton Mathematical Series) Post 8vo. pp. 152. Murray ... 3/
GRAY (John Y.) and Lowson (George) The Elements of Graphical Arithmetic and Graphical Statics. Post 8vo. pp. 122. Collins ... 3/6
SMITH (C.) A Treatise on Algebra. Post 8vo. pp. 576 Macmillan ... 7/6

General Articles.

INUNDATION CANALS.

CRATE OR CRIB-WORK.

By a combination of crates and fascines a lot of useful work can be effected in controlling and directing the water-supply. They can be used by themselves or as adjuncts to masonry works.

In crate-work only one skilled man is required to direct. All the materials can be had at or near the spot, and the neighbouring villages can supply all the labor required. It can also be carried out rapidly, and brought into use at once; whereas masonry requires a good deal of preparatory work, skilled labor, time in construction and time to set.

Matured plans in the sense of carrying some grand comprehensive schemes are not required beforehand, because crate-work admits of re-construction and re-arrangement.

The greatest care is required to prevent a creep of water round or under the crate-work. In the former case the work is speedily out-flanked, and in the latter case scour holes are soon made which soon swallow up the crate-work.

To prevent *creep under the crates* the writer's usual plan is to lay down a mattress of fascines with their lengths in the breadth of the stream. See first layer of fascines in *fig. 3*. The second layer is laid transverse to the first, and the double mattress is kept in the position by the weight of the crate. As an additional precaution before putting in the second layer of fascines, the voids due to the circular form of the fascines may be filled up with clay in which plenty of twigs are mixed up.

To prevent *creep round the flanks* of the crate-bar the whole of the excavated space, should be filled with fascines—see *fig. 2*. All these flank fascines should have their lengths in the direction of the current. After each layer of flank fascines is put down all interstices should be filled with clay well mixed with twigs; after every three or four layers have been put in water should be freely thrown on this mass and well rammed.

It is evident that by using a succession of these crate-bars, the water can be raised to any level that may be necessary. This may be done in one season or *tentatively* in successive seasons. In the case of falls the necessary contraction of waterway can be given in the up-stream crate-bar and the necessary splay outwards can be given in the side-crates of the down-stream bars. *Fig. 4* gives the arrangements that the writer finds to be the best.

When means and opportunity offer, a masonry work such as a bridge, needle regulator, &c., can be constructed on the up-stream side. With the crate-bar protection very shallow foundations may safely be used. The writer has built needle regulators with this crate protection consisting simply of a screen wall of masonry only strong enough to withstand the water pressure.

In his work on the "Merv Oasis" O'Donovan describes the raising of the water level of the Murgab River 8 feet with only fascines of giant reeds, stakes and clay. The waste weir was placed in the bund, and consisted of a shoot 10 feet wide of these fascines on an incline of about 1 in 20. As there were no crates to prevent the creep of water round these fascines 100 men had to be constantly working to replace those washed out.

In a similar case, no crates being handy, the writer banded up the main channel completely, and returned surplus water to it through numerous very crooked escapes, as shewn in *fig. 5*. Each of these was small enough to be easily controlled. This was certainly a primitive plan, but something of this sort is often useful in hasty river work.

Fig. 6 gives an isometrical view of a crate. It will be found convenient in practice that the specified dimensions of a crate should mean the space that the

crate requires, and not the rectangle made by the outside framing. In this case the crate would be considered as one measuring 6' x 6' x 4," and the dotted lines shew how these dimensions just clear the butt ends of the timber.*

All the pieces of the framing are halved one into the other, the uprights inside. † The battens are also nailed on from the inside. They are from 0.2 to 0.3 in diameter and spaced at about 0.6ft. intervals. When the crate is packed it is evident that the uprights cannot be torn out till the whole crate collapses.

The most excellent wood for crates is "*babul*" or "*ki-kar*" (*Acacia Arabica*.) It is easily worked, very tough and very durable. The "*shisham*" (*Dalbergia Sisu*) cannot be easily procured of the requisite girth, and to saw up larger scantling is too expensive. The wood of the tamarisk and poplar is generally plentiful, and easily worked, but it has not much strength. When crates of this are laid below spring level they are durable. Where exposed to wet and dry alternately they do not last more than one or two seasons.

If the blocks of burnt clay or bricks have been well packed in between the crates the decay of the crates does not seem to affect the stability of the work much. At the same time crates have been found as serviceable after fifteen years' rough work in a rapid (over which the discharge was over 1,500 cubic feet per second) as the first day they were put in.

For packing crates the writer has used blocks up to 24" x 8" x 6", burning them in an ordinary flame kiln. A better size is 18" x 6" x 4". No skilled labor is required in burning, for the whole outturn can be utilized in some way. The chief thing wanted is weight, and the best burnt surfaces should be selected for face work. For the packing at the crests of rapids well burnt blocks must of course be used.

The writer usually made his fascines 10 feet long and 2 feet in girth. The tamarisk that grows on fresh alluvion answers capitally. It is the tamarisk bush, and not the tree that answers. The writer has used the fronds of the date-palm and even the seeds of tiger-grass when nothing else was procurable within a reasonable distance. Tiger-grass for sluices was used for a 5 feet crate fall for a channel having a bed width of 18 feet, and a depth of water of from 4 to 5 feet. The foundations were laid on pure sand, and yet it has worked very well for 5 years. At the end of each season an additional line of crates was put in on the up-stream side as a precaution. The fascines should be tightly bound, and the stuff so arranged as to give an equal thickness from end to end. The fascines must pack well together or the safety of the work is endangered.

KOREISHI; February 26, 1888.

E. A. S.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK. XXIX.

Setting Eaves of tiling in lime mortar.

Items per 100 s. ft.	No. or Quantity.	Rate.	Amount.	Total.
(1)	(2)	(3)	(4)	(5)
<i>Labor.</i> —				
Masons No. ...	1	Variable.	Do.	Do.
Coolies " ...	1			
Do. " ...	1½			
Bhistie " ...	4			
Grinding Mortar c. ft.	5			
Sundries	.....		
<i>Materials.</i> —				
Lime dry powder, c. ft.	2.4			
Sand " " ...	2.4			
Surkhi " " ...	2.4			
Sundries " " ...	.....		
Petty Establishment	.....		

* A crate of this size with its butt ends on is about the largest size that can be handled without special appliances.

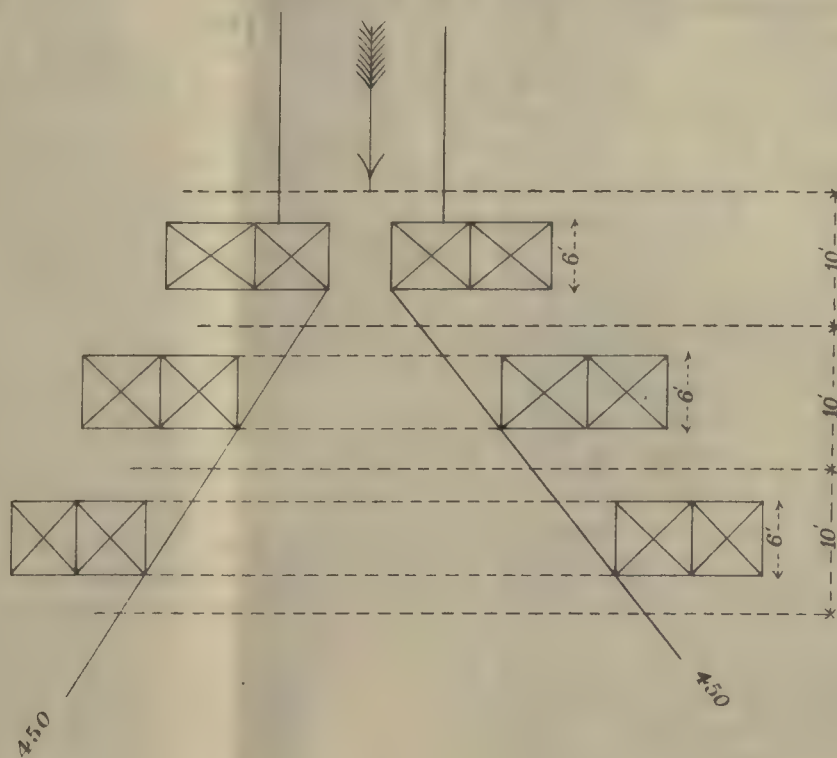
† The girths of the frame pieces should not be less than 1.5ft., or more than 2.0ft.

CANALS.

PKS.

Fig. 4.

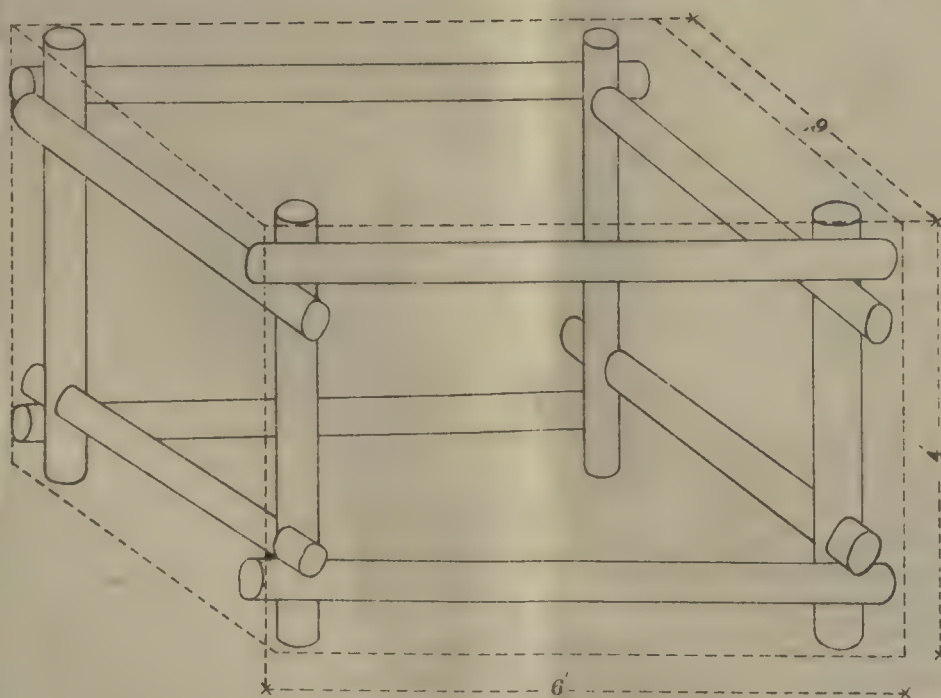
BLOCK PLAN OF A CRATE FALL.



und

Fig. 6.

ISOMETRICAL VIEW OF THE FRAME OF A CRATE.



THE MANUFACTURE OF IRON AND STEEL
IN INDIA.

V.

FOR the production of one ton of finished iron or steel the following quantities of the available materials are necessary in our case:—

			Tons.
Iron ores	...	...	1-80
Charcoal	...	...	1-30
Mineral coal from Warora	...	...	3-00
Limestone	...	...	0-03

From these proportions it may be seen that the quantity of fuel is more than double that of ore. On this account, and as besides, for well-known reasons, the carriage of ores, even weight for weight, is cheaper than the carriage of fuel, and store of them easier kept, an iron-work should always be built as near as possible to the sources of the fuel.

It may also be remarked that the carriage of charcoal is dearer than the carriage of mineral coal.

A suitable place for the iron-work would be Durgapore on the Erau stream. This place is surrounded by forests, has enough water even in the driest season, has a firm ground for building, and heavy machinery, cheap stone and lime, has also the advantage of being situated somewhat high, and is therefore more within the influences of the breezes, which would keep the iron-work cool.

This place could also be cheaply put into communication with Lohara and Warora by means of a tramway, as there are neither hills to cross nor expensive bridges to make. The suitability of this place, however, is best proved by the Map-plan furnished with last article and attention should also be drawn to the important fact that this place, on the Erau stream, is the only one between Lohara and Warora, on which a sufficient supply of water all the year round may be relied upon.

There is no doubt that with such excellent raw material as the Chanda district possesses, an excellent quality of cast-iron may be produced, and it follows also that only such cast-iron goods should here be turned out in which a good quality of iron is of importance, and which are therefore sold at *higher* prices.

An article very much in use, and the manufacture of which would be particularly suitable to our circumstances, would be cast-iron railway wheels.

It is a strange fact that for a long time, and almost exclusively, cast-iron wheels have been used on the railways on the American Continent, not only with goods and passenger wagons, but also with locomotives; whilst in Europe they are generally used with goods wagons, never with passenger wagons, and by no means with locomotives.

Considering the enormous extension of railways in America—the mileage being greater than that of England, Germany, Austria, France, and Russia taken together—it might be correctly presumed that the Americans have good experience in this matter. When the great difference in the price of a cast-iron wheel and a wheel of wrought-iron and steel is considered, in conjunction with the enormous quantity used, the subject becomes of some importance. On the other hand, it may be assumed that the Engineers in Europe, to whom the use of cast-iron wheels is no secret, have also good reasons for abiding by wrought-iron and steel wheels. The fact of cast-iron wheels being, on European railways, limited to goods wagons, would point to a want of confidence in the safety of such wheels against brittleness, whilst the confidence in America in the freedom from brittleness can only be due to the wheels being made of a more reliable quality of cast-iron and under a corresponding manipulation. To enter into the details of manufacturing this article would be out of place here; let it suffice to say that in this matter the greatest care has to be used in the choice of the materials, as well as in the fabrication, if the article is to be free from flaws and reliable in every respect.

Before putting in use, each wheel is subjected to the

most rigid tests for solidity, strength, sufficient hardness in the flanges, and general manufacture. The material used in America for cast-iron wagon wheels is grey pig-iron, obtained from rich and pure red iron ore melted with charcoal, corresponding, therefore, exactly with our circumstances.

The usual duration of such wheels is of that degree that they are allowed to run 60,000 miles in full confidence before they are subjected to new tests as to their further utility.

At the late Philadelphia Exhibition four such wheels were shewn which had run 450,000 miles without having suffered in substance or appearance. Another speciality suitable for the present circumstances is the production of malleable castings. For this article also pig-iron of the best quality (reduced with charcoal) is adapted. To explain it in a few words, the cast articles are imbedded in material giving off oxygen, and slowly heated, whereby the carbon is driven out of the cast-iron to a certain degree, the final product being one of steel-like nature. As a decarbonising means in our case the manganese ores of Malaghar and Ramtek (see Map-plan) can be made use of. The fabrication of malleable iron has lately been brought to great perfection in certain parts of Europe and America. The following articles might be here produced: ploughshares, scythes, hay-forks, rakes, and other agricultural implements; also stirrups, horse-bits, keys, small wheels, certain parts for guns, rifles, and other weapons, double-eyes and other parts of machinery, and in general such articles of complicated shapes in which great strength is not required, articles which it would be difficult to make of forge-iron.

The "spiegeleisen" necessary for the production of steel in the Bessemer converter cannot be obtained from the iron ores of Chanda, as, notwithstanding their purity, their contents of manganese is very slight; "spiegeleisen" would therefore have to be imported. From the purity and uniformity of the ores and fuel treated of, it may at once be concluded that the product of the blast-furnace will also be pure and uniform, and that it will therefore be possible to allow the pig-iron to run in a fluid state *direct* from the blast-furnace into the Bessemer converter, for the manufacture of steel, whereby the cost of re-melting would be saved, as is successfully done in Carinthia, Styria and Sweden, where the working is carried on under conditions similar to those in our case.

The finishing process of rolling the Bessemer ingots into rails, tyres, plates, &c., requires no particularly high temperature, and can therefore be effected with Warora coal of *second* quality, *viz.*, slack coal at Rs. 2-0 per ton.

It may not be out of place here to meet an objection arising from an opinion still often entertained, that for the purpose of producing "spiegeleisen" manganese, ores may be added to iron ores devoid of it, by introducing it into the blast-furnace in proper quantities along with the iron ore.

This question may be raised in our case, as manganese ore is found not far from the iron ores (see Map-plan). All such attempts have failed in practice owing to the difficulty of reducing manganese ore. It is found that the iron ore is reduced (the oxygen driven out) and carbonised, therefore ready for the melting process when the manganese ore, which had been put in simultaneously with the other, has scarcely commenced giving off its oxygen; in other words, has scarcely commenced to be reduced.

The natural consequence then results that the manganese ore (reaching the melting zone almost unchanged) is fused in this condition and forms a good part of the blast-furnace slags without amalgamating itself with the pig-iron.

The simultaneous reduction of oxide of manganese and oxide of iron can only take place when the particles of both are most intimately mixed, which is the case in iron ores containing a large percentage of oxide of manganese.

An alloy of metallic iron and manganese, the so-called

"ferromanganese," can be obtained by certain manipulations; but as "ferromanganese" cannot replace "spiegeleisen," this process is not worth further consideration in this place.

The following is the estimated cost of one ton iron ore, fuel and flux, including freight to the place where an iron-work might suitably be erected (*vide* Plan No. 1)

Iron ore of Lohara	...	Rs.	3	4	0
Charcoal	...	"	7	0	0
Large Coal	...	"	6	0	0
Slack "	...	"	3	0	0
Limestone	...	"	3	0	0

It will not be out of place here to bring to notice a new process of iron and steel-making *directly* of ores, which may, under the present conditions, deserve consideration.

This process consists in melting a certain amount of pig-iron of the best quality in an open-hearth furnace and adding to the thin fluid metal bath so obtained iron ores till the matter has been decarbonised. It is the oxygen in the iron ore which is here the decarbonising factor, the metallic iron being reduced and dissolved in the metal bath.

This adding of iron ore is continued till the whole of the pig-iron has been decarbonised (which is experimentally ascertained) when "spiegeleisen" or "ferromanganese" is added as in the Bessemer converter, for the production of a given quality of steel.

It is scarcely necessary to prove that for this process iron ores of the best quality, like those of Chanda, are required.

It should be, however, pointed out that the process under explanation requires a very high degree of heat, as the metal bath has to remain perfectly liquid even in a decarbonised state; the metal bath must also be covered with a layer of slags about 3 inches thick as a protection against the flame hovering over it, which would act injuriously upon the ores floating on the surface of the bath till they are dissolved.

(To be continued.)

LIGHTNING CONDUCTORS.

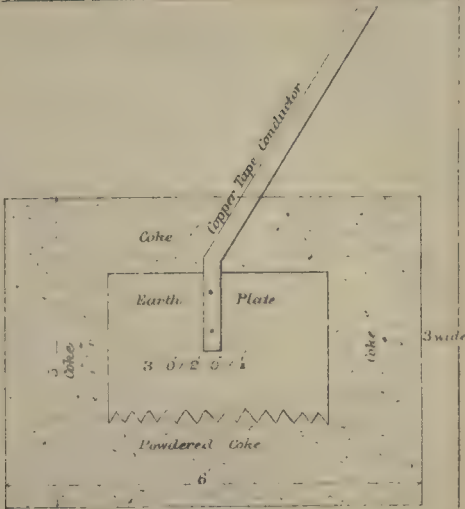
THE term "Electricity" is derived from the Greek word '*electron*,' which means amber, from a discovery made by these people of one of the properties of the latter, when rubbed, of attracting substances; but beyond a few minor incidents there is nothing to shew us that the ancients possessed any knowledge of the science, if they did, it must have been vague. They believed, it is said, that lightning never struck further than a few feet into the earth, and were sensitive of the effects and damage that it was capable of creating. Sealskin was supposed to be an infallible protection from lightning stroke. Tents were made of it, and we read of the Emperor Augustus always carrying one about his person: he trembled we are told, at the approach of a storm, and would slink away into the cellars of his palace on the sound of thunder, which was quite unbecoming, we should say, the character of one of the greatest generals and rulers of the age. Such behaviour could be better described in the history of an arrant coward and tyrant such as Caligula, who, we are informed, used to be struck with terror at the appearance of lightning, and would crawl away and hide himself under his bed, or wherever he thought there was shelter to be had. The ancient inhabitants of Russia regarded thunder as an evil deity. The Peruvians, who were sun-worshippers, looked upon it as a direct curse of their god, the places struck by lightning were marked off with signs, and no person under penalty of being ex-communicated from their fellowship, was allowed to enter them. In the year 1600 Dr. Gilbert wrote a treatise on electricity. Afterwards our knowledge was extended by the writings and teachings of those great philosophers Boyle, Newton, the Abbé Chappe, Franklin and Richmann. To account for the phenomenon of the electric current, perhaps no truer illustration could be found than the simple story of

the boy and the kite, which is too well-known to need repetition here. Dr. Franklin's theory was, that all terrestrial bodies possessed a natural quantity of the electric fluid, but that its effects became known only when one substance contained more or less than the natural quantity, which condition was brought about by friction? When a piece of glass is rubbed by the hand the equilibrium is lost, the electric fluid passing from the hand to the glass, so that the hand is made to contain less and the glass more than its ordinary proportion. These two opposite states are called the *positive* and *negative*, and it is when these two opposite forces tend to unite as in the case of storm clouds a flash of light is seen. A "flash" may take place between two clouds or between a cloud and the earth. It is in the latter case that there is any danger of mischief being done, according to the distance from which the discharge takes place, and the higher an object is from the ground the greater risk it stands of being struck, and hence arises the necessity of employing some medium by which this danger can be intercepted. The object of the lightning conductor is to prevent electric discharges within the protected area, or to act as a channel for the safe passage of the fluid to the earth. To accomplish the end for which it is designed, certain conditions are laid down, each of which has been based on theory and observations. The matter has been thoroughly sifted and attention drawn to the importance of the subject time after time. Several influential persons have got together, and, with the aid of the best talent available, drafted from all the learned institutions of Europe, formed a conference, and framed a code of rules which leave nothing to be disputed. It now remains to be seen if these rules are at all attended to, and in this city in particular; whether it is because many are ignorant that any such rules exist, or owing to the neglect of some of the principal items: wherever the fault lies, it must be admitted that the precautions taken in Calcutta with regard to the arrangement of conductors are not in accordance with the scientific character of the proceedings, and it is surprising that we do not hear of many more accidents from lightning than what are occasionally reported. Perhaps the river in near proximity has some influence in drawing aside the danger. The illustrations given by me are in accordance with the rules and specifications drawn up by the "Lightning Rod Conference" and notes that I have taken from time to time.

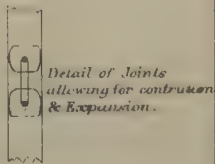
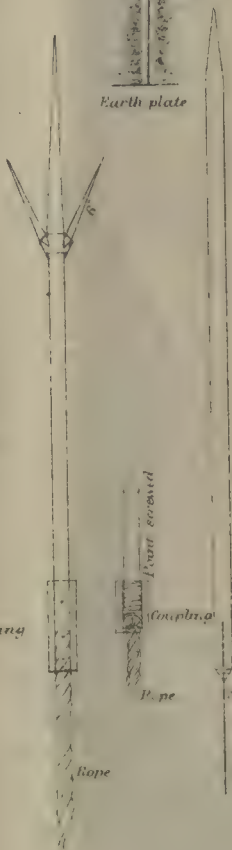
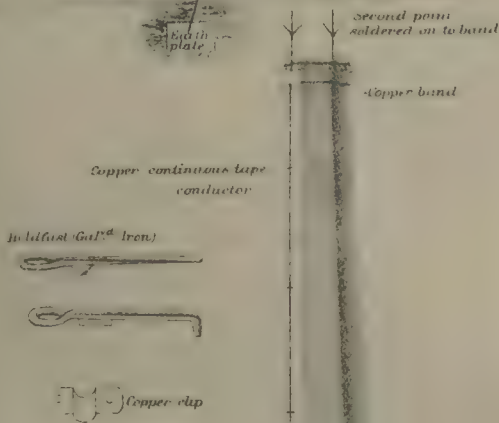
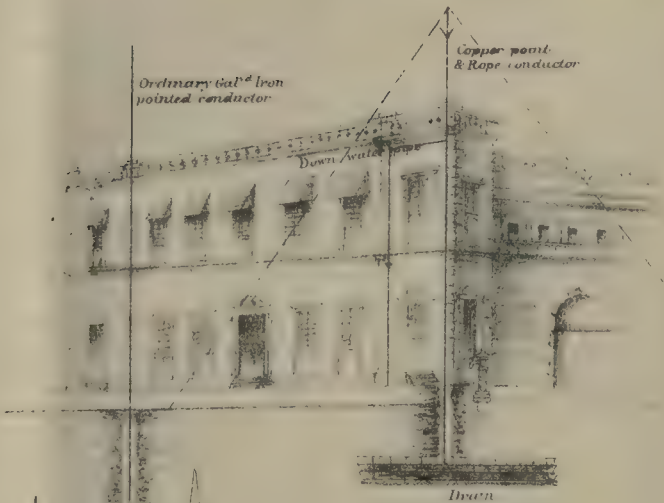
When an electrified body is brought towards another, which is not electrical, the latter is thrown into the opposite state of electricity as long as the excited body remains in its neighbourhood; and this condition of electrical disturbance, set up without any conduct or supply of electricity, is called *induction*. The discharge between the thunder-cloud and the earth, takes place when the latter by the induction from the electricity of the clouds becomes charged with contrary or negative electricity, and when the tendency of the positive and negative forces to combine exceeds the resistance of the air. The lightning conductor has been designed to either prevent discharges by drawing off the free electricity which surrounds it, leading it into the atmosphere above and thereby neutralizing the positive fluid, or if a discharge does take place through any sudden cause, the conductor, which is the nearest object, and offering the least resistance, receives the stroke and carries it safely to the ground. If the earth connections are good, the danger is over; but if otherwise, a great amount of injury may be done. If the earth connections are not perfect, just as it happens when there is no conductor at hand, the lightning strikes the earth, and tries to seek out a place where to lodge itself; if it cannot do this effectually it flies off in some other direction, where perhaps it meets with a partial conductor, then in another and so on till it finally settles in some water-pipe, tank or in the earth in a more favorable part. It is the same with the conductor if the earth connections are not good, and the supposed conductor is simply lodged a foot or two

LIGHTNING CONDUCTORS

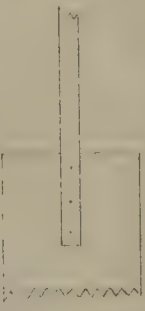
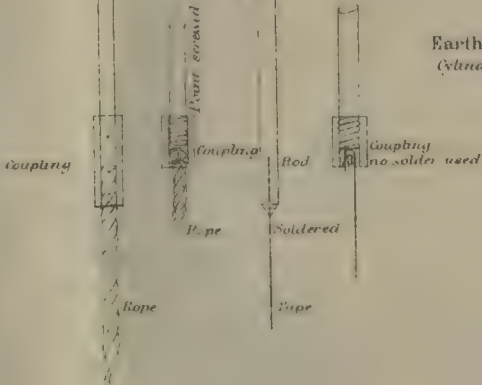
Shewing General arrangement,
AND
Various Modes of attachment.



Earth Connection
Usual Method



Earth Connections.
Cylindrical Plate



below ground, say on a stone block, or perhaps built into masonry, which is not an improbable course some would adopt to give the rod a support, out of ignorance of its use. In any of these cases the lightning, which is all along "high tension" on meeting a current of the opposite nature, will be the cause of a violent discharge, which will rend the block of stone or masonry or leap off as explained above, in the direction of the building, where the result can be better imagined than described.

An amusing story is told of a certain *vali*, or governor, of Scutari, which accounts for the destruction of the castle there. It appears that this individual was informed that a learned man, or *giaour*, by name Franklin, had invented a contrivance by the careful use of which lightning strokes were rendered harmless. He at once made up his mind to get one of these wonderful machines, but thought the price rather high. Yet something was to be done to satisfy his curiosity and great desire to become the happy possessor of one, so he immediately sent for a part of a conductor from abroad, thinking that the lower portion was unnecessary, and when it arrived had it erected over the powder magazine of the castle. A day arrived (after a succession of many months of fine weather, during which our friend was beginning to get impatient and annoyed) on which a heavy storm came on, and the *vali* took up a position where he could get a good view of what was going on, and awaited the result. Shortly a flash was seen followed by a tremendous report, and when all was over, the unfortunate governor had the misfortune of beholding his favorite castle in ruins. His feelings can be still better imagined when the information was brought him that a certain chief of the place, remarking on this great scientific hobby of his, said, "God is great and the *vali* is an ass! He has swallowed the *Giaour's* dart and paid them for it in the bargain. His face is blackened for ever. Allah's will be done."—*Travels in Upper Albania, by Spiridon Gopceovich.*

There are several rules to be observed with regard to designing of conductors, which I will try and explain in a concise form. *First.* The metal must be selected. There are only two descriptions to choose from—iron or copper. Iron is cheaper than copper, but its conductive power is about $\frac{1}{3}$ th less. The relative conducting power of the several metals is as follows:—

Silver	100	Zinc	29	Tin	14	Platinum	8
Copper	92	Bronze	22	Iron	13	German Silver	5.9
Gold	65	Brass	18	Lead	8.3	Bismuth	1.9

Iron to be effectual should be galvanized. If not, when it begins to rust, this acts as an impediment to the progress of the electricity, for rust is a non-conductor. I don't think there are many rods in this city that are galvanized. I have seen several of them tarred or painted over, which certainly does not improve them. *Second.*—Every conductor should terminate in a point, for the simple reason that a point offers the best and easiest passage for the egress and ingress of the fluids. There is no necessity for having a zig-zag arrangement. A straight point is all that is required, but in the case of copper terminals it is recommended, that a foot below the top a collar should be fixed on, with three or four points about 6" each, screwed in and soldered. *Third.*—The passage must be continuous, that is to say, the conductor should have no joints if possible, except of course where it cannot be helped, as for instance, at the junction of the terminal and the rest, a single joint may not matter much, and it should be of the one metal throughout. *Fourth.*—Insulation is not permitted under any condition. The conductor should be attached to the building by hooks or clips of the same metal as its own, allowing a little slip for expansion or contraction. Insulating, they say, robs a rod of some of its power, for when a rod gets inductively excited on the approach of a storm-cloud, it draws off the electricity which accumulates about the building, and thus prevents disruptive discharges, whereas if it is insulated it may be the cause of such disturbances. How many buildings are there where these precautions are taken? The generality of

them you will notice are held out from the wall by wooden brackets. *Fifth.*—Conductors should be led for some distance into the earth below, till soft or wet soil is reached; either that or into a well, drain, or swamp near by: and again the lower extremity might be riveted to an earth plate, either flat or cylindrical, of not less than 9 square feet of superficial area, and the space about filled with coke or cinders. A practice should be made of leading the water from the down pipes or spouts, or any pump near by on to the surface in contact, so that the lightning discharge might be distributed over as large an area as possible. The earth plate must be of the same metal as the conductor, otherwise destructive galvanic action will set in. Chain connections are not to be relied upon; it is far better that the conductor should be in direct contact with the plate and fixed to it. In conclusion, it is recommended, that buildings of any great length should be protected by three or more vertical conductors, and these should be joined by horizontal ones, especially where there is any metallic work about the building, it should be connected with the conducting system. To prevent explosion during transmission, long lines of horizontal conduction should have intermediate earth connections. The free electricity with which buildings are charged by induction will in every case accumulate with the greatest intensity about the ridges or gables, it is therefore necessary to place a point at each gable. Every chimney or ventilator too, should have a point attached to it, and in the case of factory chimneys, there should be a copper band round the top and stout sharp copper points about 1 foot long placed at intervals throughout the circumference, in order to offer a path of superior conduction to that of the heated air ascending from the chimney.

The probable cost of the different sections and descriptions of material commonly employed for the purpose of electrical conduction, will be as follows:—

Iron.	Galvd. Iron	Copper	Tape.	Galvd. Iron	Copper
				Rope	Rope.
1" dia. @ /6 ft.	@ /8 ft.	$\frac{3}{4} \times \frac{1}{2}$ @	/12 ft.	9 B. W. G.	7 strand.
$1\frac{1}{4}$ " @ /8 ft.	@ /12 ft.	$1\frac{1}{4} \times \frac{1}{2}$ @	1/2 ft.	or $\frac{3}{4}$ " dia. @	/2 ft. @ /10 ft
$1\frac{1}{2}$ " @ /12 ft.	@ /1 ft.	$1\frac{1}{2} \times \frac{1}{2}$ @	1/8 ft.		

The copper terminal, coupling, and earth-plate, will be extra, say terminal 5' long with collar and three spikes, about Rs. 30, coupling Rs. 5, and earth-plate Rs. 25. The above in galvanised iron will cost Rs. 7-8, 1-12, and 5, respectively. J. N. CONNELLY.

EXPERIMENTS ON BELLITE IN BELGIUM.

[Translated expressly for INDIAN ENGINEERING from "Annales Industrielles."]

BELLITE is a new explosive manufactured in Sweden which bids fair to oust dynamite for blasting operations.

The following experiments took place on the 19th December at Borgherout, near Antwerp, and lasted from mid-day until three in the afternoon. The experiments were conducted under the superintendence of M. Collard, Captain Jannsen, and others. The inventor, M. Lamm, manager of a manufactory of bellite at Rotebra, near Stockholm, was represented by M. Herlitz and by the Consul-General of Sweden and Norway.

The explosive was in a large tin plate box, and resembled in color and pulverulence nothing so much as Nestlé's infant's food. First of all a large cartridge was filled with bellite into which a lighted Bechford fuse was inserted. The fuse burnt right out to the bottom without igniting the bellite. Another charge furnished with a fulminating cap exploded with a loud detonation, excavating a large hole in the ground, although the cartridge had been placed on the surface, which proves the explosive to be of great power.

The third experiment consisted in placing two cartridges of bellite into a stove heated to a white heat, which were seen to melt like grease, shrivelling up while burning and giving out a pretty colored flame. The fourth experiment was for the purpose of testing the force of the new compound. A tin box containing 500 grammes of bellite was placed on the ground next to a steel rail. The spectators then retired to a distance of 50 yards, and the ex-

plosive was fired by means of a fuse and fulminating cap. One piece of steel 2 feet in length was torn from the centre of the rail and hurled a long way off into the fields.

The same effect, but in an increased degree, was then produced by means of a cartridge holding 800 grammes.

Another test of the force of this explosive was made by breaking in two a bulk of pitch pine 1 foot square, into which a hole of 3 centimetres had been bored, containing a charge of 108 grammes.

This experiment was made 3 times and one of them was remarkable from the fact, that the lateral escape of the gas had cleanly split the beam up its length: this gives rise to the hope that the use of bellite in mines and quarries will be advantageous in point of view of the quality of the blocks detached by an explosion.

Another experiment suggested by the "Percuteur," of Antwerp, was made with the dynamite termed "palleine" manufactured at Arendonck, which gave results nearly the same as bellite.

It was definitely established, that bellite is absolutely unaffected by shocks. To prove this, a wooden and a tin box filled with bellite were placed against a fence and Captain Janssen fired a dozen bullets at 20 paces distance into the boxes. The boxes were naturally perforated, but the bellite did not explode. Palleine was put to the same test with similar results.

Another more conclusive proof of the impervious nature of bellite as regards explosion from shock due to another mine being fired in its proximity, which is a weak point with dynamite, was made as follows. Two cartridges of the explosive absolutely bare of any paper covering were placed side by side 5 centimetres apart, and one was fired. The first naturally blew the second to powder, but did not explode it.

Lastly a weight of 20 kilogrammes was dropped from a height of 16 feet on to some bellite enclosed by two iron plates and the charge did not explode.

The product will be experimented on further by the committee of the Belgium Artillery next March. If it is shewn that bellite will stand being fired in a shell without exploding, its safety under manipulation of any kind will be assured.

In order to fire the explosive at the proper time, either a time fuse will have to be employed, or else the penetration of the projectile into a solid body might produce the required effect. Suddenly arrested motion produces heat, which will be sufficient to light a charge of ordinary powder inside the shell, the pressure of which will explode the bellite.

NAGPUR WATER-WORKS. THE WORKING OF THE SCHEME. III.

Evaporation.

OUR knowledge on this subject has advanced no further during the last 5 years but sanction has been obtained to carry out some experiments next season.

Consumption of Water from the Reservoir.

1. The regularity of the consumption in corresponding months of each year noticed in the previous report still continues, and a Table has been drawn up showing the average consumption in each month for each series of 5 years and general averages obtained. It was observed that the least consumption is in the month of January and averages 9,723,767 cubic feet, and that the greatest consumption is in May averaging 18,123,700 cubic feet, or nearly double that in the cold weather.

The diagram attached *fig. 1*, Plate III., gives a very clear idea of the increase of consumption as the hot weather approaches.

2. In dealing with the figures of total consumption in the previous report, it was omitted to be pointed out that before a fair comparison of the consumption in each year could be made, the length of the interval between the time the reservoir fell below the waste weir level, and the time it reached the lowest level at the end of the hot season, must be taken into account.

3. In diagram No. 2, Plate III., the total consumption is given, and the number of days over which it was spread in each year. It can then be seen what a difference there must be when the length of the dry season varies from 221 to 295 days, or an interval of over 3 months. To make a fair comparison, therefore, it is clear that the quantities must be reduced to the average daily consumption. This has been done in diagram No. 3, Plate III., graphically. The extraordinary closeness of results are then much more striking than when the totals are alone considered for the whole year.

4. The averages for each of 5 years are series:—

(i.) 415,987 c. ft.

(ii.) 421,553 "

(iii.) 427,271 "

which show a slight advance for each series, but the difference is so small as to be practically *nil*.

5. The general average is 421,609 c. ft. daily, *i. e.* 2,635,054 gallons.

The population at the last census was over 100,000, but as some of the higher portions of the City are still unsupplied, it will not be far wrong, if it is assumed that, the originally estimated number, *viz.*, 84,000 people draw from the distribution pipes, and the supply per head per diem would then be 31 gallons, which includes loss by evaporation and leakage.

The average number of days interval between the monsoons is 256 or 8½ months.

6. It was seen that the daily consumption in the shortest dry season of 221 days averaged 492,122 c. ft., and in the longest dry season of 295 days, only 395,593 c. ft.

It is not quite clear why the longest interval should have the least daily consumption; it might be thought that the late rains would be conducive of large consumption, but the contrary appears to be the case, and probably with late rains the evaporation is less active towards the end of the prolonged hot season, on account of the saturation of the air. In any case the figures are difficult to explain, and it may be that the comparatively large average daily consumption in 1886-87 is merely due to the unusual dryness of the whole season, the cold weather rainfall being only 53 inches.

7. Referring once more to the average daily consumption for each series of 5 years, the regularity of the figures is the more striking when it is remembered that not only has the population of the City largely increased since 1872, but that a large extension of the distribution pipes has occurred, and when these facts are considered it is difficult to understand how the consumption shews little or no increase at the end of 15 years.

8. When the scheme was completed in 1872, there were 4½ miles of distribution pipes and 80 public drinking fountains in the City.

There are now 10½ miles of pipes, 174 public fountains and 384 private taps, and yet the astounding fact remains that the records shew little or no increase in the consumption of water.

(To be continued.)

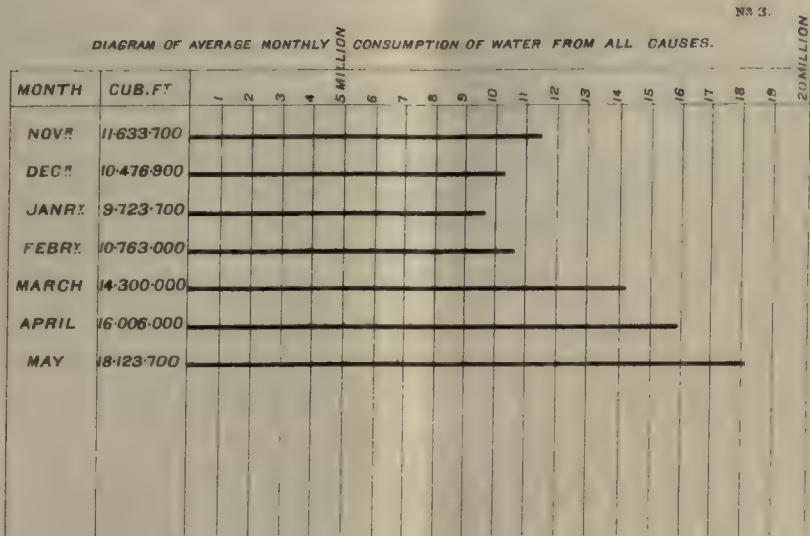
A MICROSCOPE ILLUMINATOR AND POLARIZER TO OBSERVE EXTREMELY MINUTE OBJECTS.

BY G. DUBERN.

THIS little appliance centuplicates the searching powers of the microscope and renders most distinct, objects floating in liquids, which hitherto, I believe, the very best and most powerful instruments had great difficulty in tracing at all.

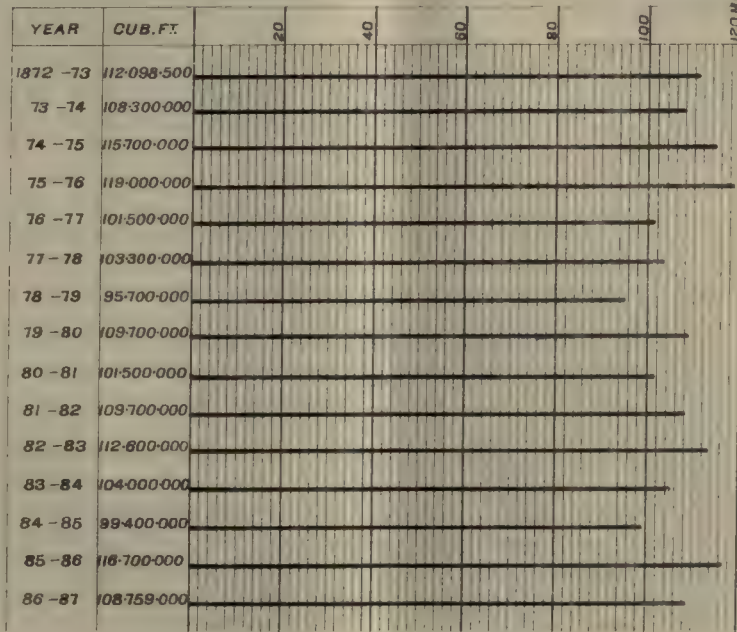
Having in view to check the accuracy of some speculations and inferences on the origin of life, and expecting to have to observe very minute germs or protozoa probably below one hundred thousandth of an inch, a preliminary investigation of the best conditions to direct the most intense light on such minute objects became necessary.

THE NAGPUR WATER WORKS.



NR 4.

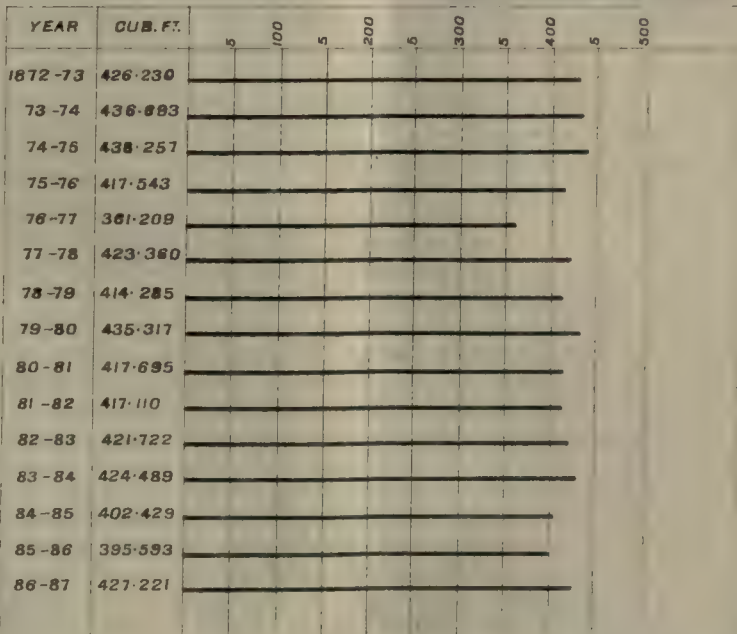
DIAGRAM OF TOTAL CONSUMPTION OF WATER IN CUB. FT. DURING EACH YEAR FROM AMBAJHERI RESERVOIR.



NR 5.

DIAGRAM OF DAILY CONSUMPTION IN CUB. FT. FROM ALL CAUSES FROM AMBAJHERI RESERVOIR.

SCALE 100-000 CUB. FT. = 1 INCH



From the want of a better course, the use of some coloring material to reveal what could not be seen without it, was no doubt often serviceable. But it must be admitted that if objects have any chance of being seen without being interfered with in any way, that is by far the better course. With this peculiar sort of investigations, that is more necessary yet, than with plain observations of a less profound character, in order that there be less room for doubts, so often surging at the limit where practical observations approach the grounds of abstract principles. Once laid down that the objects to be looked for were to remain in their natural state, there was apparently but one course left to secure sufficient definition of outline, by necessarily very transparent bodies, and that was, that anything else but the object, should be deprived as far as practicable of any light, and that no light should reach the retina but the one reflected by the objects to be observed.

To secure this last condition, or at least attempt to do so, the well known oblique lighting by a strong artificial light from under the stage was tried as a "feeler," but pure water or pure nitric acid and a very clean slide shewed no trace of the life germs sought for. Minute bubbles and scratches of the glass were very plain indeed, and no wonder, being fully one hundred times larger than what was looked for or reflecting to the eye from their surface $100 \times 100 = 10,000$ times more light than could be expected from the size of the objects hunted for. This very simple calculation pointed to the right line to be adopted; for failure of detection was rather attributed to imperfect means of observation than to actual absence of germs looked for.

Evidently no light was to be lost, and much stronger light than artificial light needs be used; specially, as with such very great angle of incidence as is necessitated by sub-stage lighting, nine-tenths of the light are reflected and totally lost to microscopic observations. Hence nothing short of the sun's light could do, even more than that was desirable, not in quantity, but certainly in intensity; hence a lens was adopted to focus the sun's light to a dot. But this, it needs be said, was in direct opposition to all scientific instructions on the microscope. Of course any organic substance placed at such focussing of the sun's rays, as is well known, is either baked at once, or even set on fire. Yet such intensity of light was nevertheless indicated as useful, though the heat was no doubt extremely objectionable. One was to be kept, the other eliminated. It was also most desirable to have polarized lighting of the field where the searching was to proceed.

The above several conditions were partly satisfied by an extremely simple disposition, namely, by inclining very much the condensing lens to the sun's direct rays, in order to diminish the extreme heat of a circular focus of rays, and to transform it into a narrow long one. By careful adjustment, some monochromatic lighting of part of the field was possible, just as well as something approaching to polarized light. With great patience and perseverance, often set at naught through the sun continually altering the several adjustments, from its diurnal motion, it was possible to light the field directly from above, and somewhat in the usual manner adopted for opaque objects, but make it subservient to transparent objects observation. Now and then, for some seconds or a minute, a very great deal more was to be seen of what there is in the best filtered water or in the purest nitric acid than is customary with the recognised way of lighting the microscope field. In fact, in one case nothing at all is to be seen, and in the other way thousands of glittering, sparkling and grovelling little star-like specks shew themselves. The main object in view had therefore been perceived, but the way of observing it was so incommensurable, so unpractical that better dispositions need be designed at once.

The conditions to be carried into practice were—

1st.—The greatest or most intense lighting possible of object,

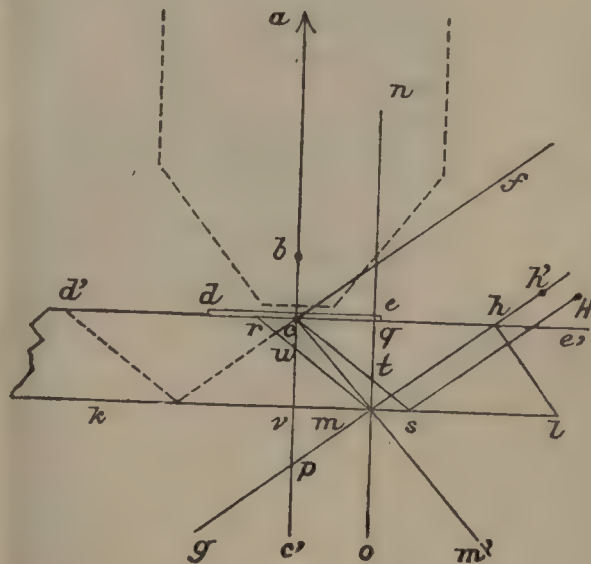
2nd.—Injurious heat to the observed object to be avoided.

3rd.—No light to enter into the microscope (so far as at all practicable) except the one reflected by the object.

4th.—Polarized lighting of object.

All the above cannot be rigorously carried out, specially when it is in connection with an instrument which shews a hair as thick as one's thumb, and more; but the theoretical investigation of what is needed is excellent guidance to determine to what extent some conditions may be sacrificed in order to keep to others.

Fig. 1.



FIRST.

In fig. 1, let C be the object to be lit. Nearly normal and direct application of the sun's focussed rays would of course give the greatest intensity of lighting. A constructive difficulty is met at first as shewn by the dotted lines representing the mounting pieces coming in the way of light rays, as by hypothesis, the $1-100,000$ th of an inch size of objects is to be observed. This requires high powers, and therefore a very small intervening space between the object and the first lens of the object piece.

The ordinary normal lighting from below with such intense light would send torrents of light into the microscope. Hence there remains only very oblique or entirely horizontal side lighting. Very oblique lighting means a very large angle of incidence and a very great loss of light: therefore, there remains only side lighting as having any chance of success.

SECOND.

Intense light and heat to a great extent go together, but one may be transformed or absorbed without the other undergoing a proportionate transformation.

It is found practically that through reflection of both light and heat, after one or more such reflections much more light than heat is reflected, and that the ratio of elimination of heat is a very fast increasing one relatively to the other.

There is also another way, which is to transmit light and heat through a certain thickness of liquids holding certain salts in solution, but this is not so convenient for microscopic use.

THIRD.

There are considerable difficulties to fulfill these conditions from the fact that whatever be tried a sufficiently polished reflecting surface cannot be produced so as not to give some diffused light.

Though this may not be felt in ordinary optical experiments, it is, as everything else, much magnified by the microscope. However, there is an indirect way of meeting the difficulty, namely, to use such powers of amplification as to place out of focus other light-reflecting objects than the very ones under observation. The angle of total

reflection of light by glass may be of great assistance to prevent undesirable light entering the body of the microscope.

FOURTH.

Polarization of light is already reduced to very well defined practice and may be used several ways. No. 2 set of considerations indicating that reflection of light and heat should be adopted, also point to polarization by reflection instead of polarization by transmission through crystalline substances.

To meet several of the above requirements, the light should be reflected at an angle of $54^{\circ} 35'$ to the normal of the reflecting surface. Also as far as practicable, all rays of light besides the legitimate normal ones entering the microscope should meet the glass cover of object at an angle of total reflection, or at a less complimentary angle of the critical angle of glass to air, i.e., at a less angle than $90^{\circ} - 41^{\circ} 48' = 48^{\circ} 12'$.

These are the theoretical considerations embodying the requirements to obtain the object in view.

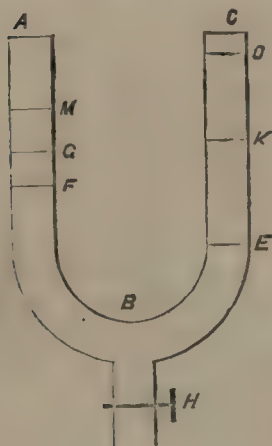
(To be continued.)

PROPERTIES OF FLUIDS.

By A. EWBANK.

VIII.

Fig. 11.



WE may now indicate what we called an imperfect experiment with a bent tube. Suppose we have only a short bent tube, as in *fig. 11*, and we fill it completely with water. Then let A be closed, and the tap H opened. Water will flow out, and the level in the right hand branch will descend to E. But the water in the left branch will refuse to move. In order to induce the water to leave A, we should require a column A B more than 30 feet in length. If, however, we do not close the tap when the level in the C branch has nearly reached B, we may have a different result. For after all the water between C and B has flowed out air may creep round B and begin to ascend the A branch. As air rises to A water will begin to leave the A branch. This process will be expedited if we slightly tilt the tube, so that the end C becomes lower than the end A. We do not tilt the tube till after the water C B has escaped.

Another experiment with a short bent tube is as follows. Fill tube *fig. 11* up to some level G, and then close A. Now open H. Then the water in the C branch will fall rapidly, while that in the A branch moves very slowly. When the level in the C branch has nearly reached B, close the tap. Then the fluid in the A branch will be seen to have altered the level of its free surface by a small quantity G F. Any fluid may be used for this experiment, but mercury is most suitable. The tube may be half full initially, so that G is about midway between A and B.

This experiment introduces us to another property of the air. This property was by Boyle, its first discoverer, called the spring of the air. In modern times it is usually called elasticity of the air. The word elastic is used by mathematicians in a wider sense than it possesses in ordinary speech. Ask a man to define the term

elastic, and he will probably instance a band of india-rubber which can be elongated by tension, and which contracts to its original length when the force on it ceases.

Mathematicians also would call this a case of elasticity. But they would say that not only is india-rubber elastic, but glass and some other bodies. A sword of good steel is elastic, although it could not be perceptibly elongated by an ordinary pulling force.

Suppose we have a ball made of glass, and we drop the ball on a stone floor. The ball if it does not break will rebound. This rebound is to the mathematicians a proof of elasticity. At the moment the ball strikes the ground, the under surface of the ball becomes slightly flattened. The glass thereupon struggles to recover its perfect roundness, and in the effort jumps up from the ground. An india-rubber ball—by which we mean a ball of solid india-rubber—behaves in a similar way. Here the india-rubber instead of being stretched by a force and contracting when the force is removed does on the contrary contract under the force or pressure and expand when the pressure is removed. Thus the mathematicians would call a body elastic when it expands or contracts under the influence of an appropriate force, provided always that it recovers its original size and shape when that force no longer acts.

Now instead of making a ball of solid india-rubber, it is cheaper to make it of an india-rubber shell with only air inside. Such a ball is used in several games, and it will rebound from the ground or from a wall in the same kind of way as does a ball of solid india-rubber. When this hollow ball falls on the ground, it is the inside ball or sphere of air that gets flattened. It is the air that endeavours to recover its original volume, and, in doing so, presses so violently against the ground that the ball shoots into the air. This shooting up into the air as a consequence of the ball pressing the ground may be illustrated as follows.

Let a man in a small boat press with his oar or hand against a large vessel anchored alongside. He will not press the vessel away, but he will cause himself and his little boat to start in the opposite direction.

In *fig. 11* we had a liquid at the level G K with air above K and G. On closing A and allowing liquid to escape at H the free surface G sank to F. The free surface in the C branch had then sunk to E. Now upon E pour more liquid until the level returns to K. The other free surface has returned to G. Continue to pour fresh liquid. Then in the C branch the level rises rapidly to O. In the left branch the level rises more slowly and reaches some place M, which is lower than O. There is thus some force acting in the left branch which presents the liquid rising as readily as does the liquid in the right branch. The one branch is closed, the other is open.

Let us now open the end A. The fluid at M immediately rises while that at O sinks, and the two free surfaces acquire the one common level. When we commenced to pour fluid on E the air between A and F commenced to contract. The air however resisted this contraction and the resistance kept the liquid in the left branch from rising freely. When A was opened some of the air in A M escaped and the liquid then yielded freely to its tendency to acquire the same level in the two branches.

If we pour liquid upon E slowly and with such steadiness that in every second we add the same quantity of liquid, we shall see that the level in the left branch instead of rising uniformly rises more and more slowly, so that if it rises a distance x in the first second, it rises less than x in the next second. In the right hand branch the reverse is the case. If the liquid there rises y in the first second, it will rise more than y in the next second. Here however we are tacitly assuming that the section of the bent tube is exactly the same throughout.

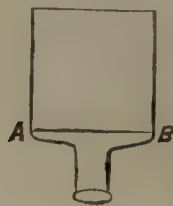
When the air occupies the volume A G it is said to be of common density. When it expands to A T it is said to be rarefied. When it contracts to A M it is said to be condensed.

If the C branch be elongated by attaching another straight tube to C we may continue to pour fresh liquid. The level M will then rise with ever-increasing slowness, so that it presently seems to have ceased moving. The air inside A is meanwhile getting compressed. If in this experiment we turn our attention to the covering at A, we shall be able to convince ourselves that the pressure on its under side—which pressure acts upwards—is now greater than the outside air pressure, which pressure acts downwards. So that instead of the finger feeling sucked into the tube we become conscious of a difficulty in keeping the finger pressed on to the tube. We have now learned that our ordinary experiments with water, treacle, mercury or other fluids are incidentally conducted in the presence and under the pressure of a fluid which we call the atmosphere. When we say an open vessel is empty we mean it is full of air. We do not see the air with our eyes, but we learn to recognise its presence by other means.

Suppose now that at the bottom of the ocean there live beings called usually mermen and mermaids. We shall however call them mermen and merwomen, seeing they may be fathers and mothers. Let these people have some appliances of civilisation such as closed bottles, open glasses, mercury and some other liquids. In the mer-world when they say an open vessel is empty they mean it is full of water. Water to these folk may be as invisible as air is to us. In fact, when we are swimming under water we cannot see the fluid around us, though we feel it, and we see objects through it.

Let a merman pour some mercury into what he calls an empty vessel. The mercury will sink through the invisible water and collect at the bottom of the vessel, having its free surface horizontal. The space not taken up by mercury will remain "empty"—that is, full of water. If mercury is poured into one branch of an open bent tube, such as we had in *fig 11*, the mercury will rise in the other branch and there will be two free surfaces at the same levels. The remaining parts of the branches will be "empty," that is, full only of water. If these mer-folk have succeeded in producing oil they must keep it in closed bottles. If a thoughtless merwife tries to pour oil from one of these bottles into a glass which is empty—except for the water in it, and which has its open end upwards—the oil if it leaves the bottle will not sink through the water in the glass as did the mercury. On the contrary no sooner has the oil left the bottle than it will in "bubbles" or round masses travel upwards to the top of the ocean. Possibly the merboys and mergirls watching the process would call them air bubbles, possibly also these mer-children would say that oil has no weight.

Fig. 12.



Oil may be kept by the mer-citizens in open bottles, provided these bottles are inverted as in *fig (12)*. If the bottle is not full of oil the under portion of the bottle will be empty, that is, full of water. Thus we may have, as in *fig 12*, the space below A B full of water. If the bottle thus partially filled with oil be first corked and then be inverted so that it may take what we who live on dry land would call the natural position of the bottle, we shall see the oil taking the topmost place, *i.e.*, near the neck and the emptiness—as the mer-folk might say—filling the bottom. But they would not speak of emptiness filling a space. They might only consider that oil was a body inherently given to taking the topmost situation. Now all that these thoughtful or thoughtless mer-folk

notice in the case of water, we may notice in the case of air. As they may have bodies lighter than water, which cannot be kept in vessels which have open mouths pointing upwards; so we know of fluids which are lighter even than air, and these we keep in vessels which are closed or which are placed as in *fig. 12*.

Air, though light, can be weighed in ounces or pounds if we adopt certain elaborate precautions. Although the weight of one cubic foot of air is extremely small, yet the weight of the air in a large building is by no means small. As to all the air that surrounds this globe, it forms an immense mass, whose weight is not conveniently to be measured either in ounces or pounds, but by some much larger unit, say, a weight of 1,000 tons.

NOTES FROM HOME.

(From our own Correspondent.)

THE new Bournemouth Direct Railway, which has just been completed by the London and South-Western Railway Company, and which shortens the journey between London and Bournemouth by an hour, was opened on the 5th instant with considerable ceremony, the town itself being *en fête*.

The *Railway News* says the late attack upon the Chairman of the Metropolitan Railway Company was carefully planned under the auspices of a "triple alliance" of Mr. Gladstone, Sir E. Watkin and the discharged officials of the District Company. In this article no good results are augured to railway companies from the introduction of political considerations into the administration of railway affairs, and that it will be a sad day for railway proprietors when they shall be asked to decide upon great questions affecting the administration of their property according to the politics of those to whom their interests are confided.

The stock of water for consumption in the Liverpool reservoirs has, by the comparative dry autumn and winter, been reduced to 918 million gallons, and at the present rate of consumption of over 100 million gallons per week, under a restricted supply, a water famine is apprehended in the district, unless there is a heavy rainfall. Meanwhile, supplementary supplies are being arranged for, and, in some cases, with success from adjacent towns. As the new source of supply from Vrnwy Lake will not come to Liverpool for 18 months the outlook is considered an ominous one.

Coming nearer home, a note of warning as to the possible condition of the Thames next summer was sounded at a recent meeting of the Metropolitan Board of Works. It was there moved that advertisements be at once issued inviting tenders for the supply of 2,000 tons of permanganate of soda, to be delivered at the rate of 100 tons a week from the first week in May. In support of this it was pointed out that there was every probability of the river becoming foul as soon as the warm weather set in. According to the Registrar-General's return the rainfall during 1887 was only 18·8 inches, as compared with an average of 27 inches per annum. At the present time there is coming over Teddington weir very little more than half the normal flow of water from the Upper Thames, and for the last three months the state of the river has been worse than it usually has been during the winter.

A scheme is now under the consideration of the Paris Municipality for the supply to that City of water from the Lake of Neufchatel. The distance is 312 miles and the surface of the Lake is 1,620 feet higher than the mean level of Paris, while its area is 135 square miles. To carry out this project, a tunnel 22 miles long will have to be constructed under the Jura Mountains, leading to an arched conduit along the slope of the hills ending at a point 394 feet above Paris. A flow of 4,400 gallons per second is proposed, or rather more than twice the water-supply of London. A portion of this will be used for hydraulic power to light the City by electricity and to give motive power to mills and factories along the route. The cost is estimated at £12,000,000.

At the last meeting of the Society of Engineers a paper was read by Mr. Fajja on "The Effect of Sea Water on Portland Cement." The concrete failures at Aberdeen, which about 12 months ago caused considerable anxiety to those interested in this class of work, were first reviewed, as were also the reports and analyses upon these failures, which determines the cause of failures to be the chemical action of the sea water on the cement. Details were then given of experiments and analyses by the author, shewing that sea water has no deleterious action on good and properly used

Portland cement. Valuable and interesting comparative experiments were given on the use of cement in sea and fresh water. The paper forms an important addition to the present literature on the testing and behaviour of cement under the many conditions of its varied use.

At the recent meetings of the Institution of Civil Engineers two papers were read on "Manganese." The first entitled "Manganese in its Application to Metallurgy" and the second, "Some Novel Properties of Iron and Manganese." The first paper described the peculiar characteristics of steel, and of its conditions of hardness, toughness and brittleness and principally dealt with and described the experiments that have been made with manganese steel. The physical properties noticed in the material, and the conclusions to be drawn therefrom being more particularly defined in the second paper. Special attention was drawn to what essentially constituted the peculiarity of manganese steel. Whilst the belief hitherto held that steel became brittle and comparatively worthless when the manganese exceeded 2.75 per cent. was correct, it had now been proved that by adding more of the same metal so as to obtain in the material under treatment not less than about 7 per cent. the result was a new metal. The apparent paradox thus took place that whilst manganese alloyed with iron, if present in the proportion of not less than 2.75 and up to 7 per cent. gave a very brittle product, when its proportion was increased to not less than 7 and up to about 20 per cent. the result was a material possessing peculiar and extraordinary strength and toughness.

A Sewer Gas Destructor invented by Mr. Keeling is said to solve the difficulties met with in the ventilation of sewers with ordinary shafts. This Destructor consists of a ventilating column which contains in its base a patent gas furnace and is connected with the street sewer by suitable pipes. The whole of the sewer gas passes through narrow passages between a series of hot ribbed metal cones, and none of the gas so passing fails to reach a temperature of 350° Fahrenheit. This temperature, it need hardly be said, is sufficiently high to destroy all septic poisons and germs. The Destructor is now in operation at East Durham, Epsom, Leicester, Richmond and Ealing, and will shortly be erected at Tottenham, Croydon and other towns.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Mysore, March 24, 1888.

Mr. B. S. Venkatacharyar, Assistant Engineer, attached to the Shimoga Division, has been granted privilege leave for 17 days, with effect from the 23rd February 1888.

Burma, March 24, 1888.

Upper Burma.

With reference to *Gazette of India*, Public Works Department Notification, dated the 10th February 1888, Mr. C. A. B. Target, Executive Engineer, 1st grade, reported his arrival at Mandalay on the forenoon of the 15th instant and is temporarily attached to the Mandalay Division.

Madras, March 27, 1888.

The following transfer is ordered:—

Mr. J. D. Legge, Assistant Engineer, 2nd grade (Honorary rank), from the I. Circle, Godavari Eastern Division, to the V. Circle, South Arcot Division. To join forthwith at the public expense, the unexpired portion of Mr. Legge's privilege leave being cancelled.

Punjab, March 29, 1888.

Irrigation Branch.

Mr. T. Higham, Superintending Engineer, Sirhind Canal Circle, is allowed furlough to Europe for 12 months, with effect from the 15th April 1888, or such subsequent date as he may avail himself of the same.

Mr. F. W. Schonemann, Assistant Engineer, 3rd grade, from the 2nd Division, Bari Doab Canal, which he left on the forenoon of the 1st March 1888, to the Swat River Canal Division, which he joined on the forenoon of the 2nd March 1888.

Mr. A. B. Phelan, Executive Engineer, 1st grade, is appointed to the Executive Charge of the Karnal Division.

Bombay, March 29, 1888.

His Excellency the Right Honorable the Governor in Council is pleased to appoint Mr. W. L. Strange to act as Executive Engineer, Satara, during the absence of Mr. F. B. MacLaran on privilege leave, or until further orders.

India, March 31, 1888.

The services of Mr. A. C. Livingstone Learmonth, Executive Engineer, 3rd grade, are replaced at the disposal of the Government of the Punjab, with effect from the 1st April 1888.

The services of the Honorable L. M. St. Clair, Executive Engineer, 3rd grade, are placed temporarily at the disposal of

the Government of the Punjab, with effect from the 1st April 1888.

The services of the under-mentioned officers, who are employed on the Bellary-Kistna State Railway, are placed at the disposal, of the Southern Mahratta Railway Company with effect from the 1st January 1888:—

Mr. H. C. D. LaTouche, Superintending Engineer, 2nd class, temporary rank.

Mr. J. E. P. Lincke, Executive Engineer, 2nd grade.

Mr. B. P. Milsom, Executive Engineer, 2nd grade, sub. *pro tem*.

Mr. J. M. Harman, Executive Engineer, 3rd grade.

Mr. B. W. Cantopher, Executive Engineer, 3rd grade.

Mr. T. Michell, Executive Engineer, 3rd grade, sub. *pro tem*.

Mr. O. J. Shedlock, Executive Engineer, 4th grade, sub. *pro tem*.

Mr. R. W. L. Tooze, Executive Engineer, 4th grade, sub. *pro tem*.

Mr. J. N. D. LaTouche, Assistant Engineer, 1st grade.

Mr. G. F. Thompson, Assistant Engineer, 2nd grade.

Mr. J. C. Lyle, Assistant Engineer, 2nd grade.

Rai Bhuput Rai Sahib, Assistant Engineer, 3rd grade.

Sheo Nath, Apprentice Engineer.

Rajputana.

The Agent to the Governor-General and Chief Commissioner is pleased to grant furlough on medical certificate for one year to Mr. H. J. A. Bowden, Assistant Engineer, 1st grade, attached to the Military Works and Roads Division, with effect from the 14th March 1888, the date on which he embarked for Europe. The usual subsidiary leave is also granted to Mr. Bowden from the afternoon of the 6th to the 13th March 1888.

Military Works Department.

Lieutenant C. D. Learoyd, R.E., Assistant Engineer, 1st grade is appointed to officiate as Executive Engineer of the Meerut Division, Military Works, with effect from the 9th January 1888, during the absence on privilege leave of Captain A. Hildebrand, R.E., Executive Engineer, or until further orders.

N.-W. P. and Oudh, March 31, 1888.

Irrigation Branch.

Mr. W. P. Richardson, Executive Engineer, 1st grade, is transferred from the Cawnpore Division, Lower Ganges Canal, to the charge of the Anupshahr Division, Ganges Canal, *vice* Lieutenant-Colonel T. Howard, R.E., granted special leave.

Mr. C. T. Evans, Executive Engineer, 2nd grade, is appointed to the charge of the Cawnpore Division, Lower Ganges Canal, *vice* Mr. W. P. Richardson, transferred to the Anupshahr Division, Ganges Canal.

Buildings and Roads Branch.

Mr. H. Clifton, Honorary Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India six months' furlough on sick certificate in extension of that notified in G. O. dated 1st November 1887.

Mr. A. C. Crampton, Executive Engineer, 3rd grade, District Engineer, Allahabad, is granted nine months' furlough, with effect from such date as he may avail himself of the same.

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner of Oudh, is pleased to order the following promotion, with effect from the date specified:—

Mr. P. McKenzie from Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, from 3rd March 1888, *vice* Mr. E. Hodges, Executive Engineer, granted one year's leave on medical certificate.

Central Provinces, March 31, 1888.

Mr. E. J. Rumsby, Executive Engineer, 3rd grade, Hoshangabad Division, is granted special leave, for a period of two years, under the terms of Public Works Department letter of 3rd October 1887, with effect from 1st April or from such date as he may avail himself of it.

Bengal, April 4, 1888.

Irrigation—Establishment.

Mr. T. M. L. Thompson, Executive Engineer, attached to the Eastern Sone Division, is appointed to be Executive Engineer of the Northern Drainage and Embankment Division.

MADRAS MUNICIPALITY.

WANTED a Sanitary Inspector. Salary Rs. 100 per mensem.

Applications with testimonials to be forwarded to the undersigned, on or before the 16th April 1888.

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27th March 1888. }

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Municipal Board.

SALE OF IRON PADDLE STEAMER.

TENDERS for the purchase of the Madras Government Steam Tug *Madras*, built at Blackwall by T. A. Young in 1876, will be received by the Port Officer at Madras up to noon of Tuesday, the 1st May 1888.

2. The vessel will be sold at Calcutta with engines, boilers, masts, sails, awnings, spars, anchors, cables, boats, and such other stores as may be on board on the 30th March and which will not be removed previous to the sale.

3. Each tender, before being opened, must be accompanied by a treasury receipt for a sum equal to 25 per cent. of the amount offered, and the balance must be paid within 48 hours of acceptance of the tender and before delivery is taken. The tenders will be submitted to the Government of Madras for orders.

4. The vessel will be at the risk and charge of the purchaser from the date the acceptance of the tender by Government is communicated to him.

5. The following description of the vessel is believed to be correct, but any errors or misdescription shall not annul the sale, nor shall any compensation be allowed on that account :—

Tonnage	...	197 gross.
Do.	...	57 nett.
When built	...	In the year 1876.
Where built	...	At Blackwall.
Extreme length	...	123 feet 4 inches,
Do. breadth...	...	20 feet 8 inches.
Depth	...	11 feet 1 inch.
Number of bulkheads	...	Three.
Do. of decks...	...	One.
Engines	...	Two side lever disconnecting surface condensing.
Boilers	...	One multitubular.
Horse-power indicated	...	137.
Do. nominal	...	75
Coal that can be stowed in bunkers	...	66 tons.

6. The vessel will be open for inspection at Calcutta on applying for an order to the Deputy Director of India Marine on or after the 30th March 1888.

MADRAS PORT OFFICE, } H. A. STREET, CAPT.,
15th March 1888 } H. M.'s INDIAN MARINE, Port Officer.
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NOTICE.

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PUNJAB SECTION, Punjab Section.
Lahore, 24th March 1888.

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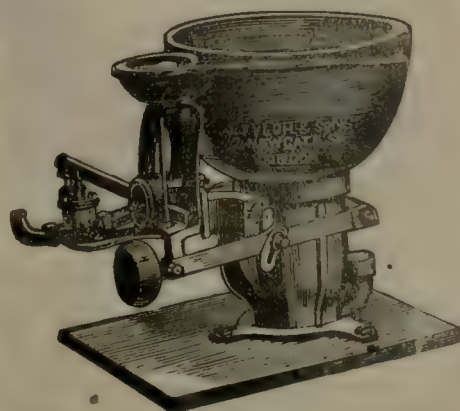
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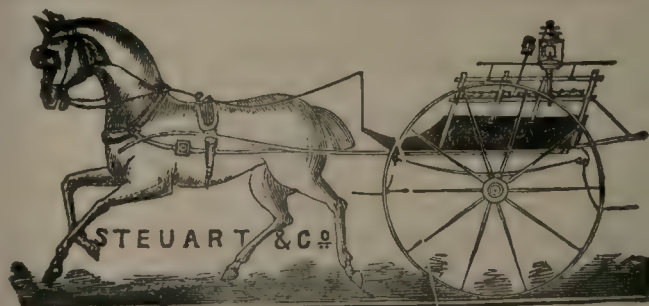
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INDIAN ENGINEERING.

SATURDAY, APRIL 14, 1888.

P. W. RE-ORGANIZATION.

THE Public Service Commission proposes that the P. W. D. should be re-organized, in the interests of economy and efficiency, and that the Engineer establishment should consist of an Imperial Branch and Provincial Branches. The Imperial Branch to be officered by Royal Engineers and Civil Engineers recruited in England, and the conditions of service to be uniform for all officers employed in it: the control and direction of the Department and the execution of the more important work and repairs to rest with this branch. Other works would be carried out by the Provincial Branches, in which the salaries, furlough rules and pensions would be fixed, without reference to those of the Imperial men; and the staff would be trained in Indian Colleges.

The report and recommendations of the Commission show that this proposal was intended to be part and parcel of a general scheme for dividing the different services into Imperial and Provincial Branches; the former composed of highly trained men appointed from home, and the latter of the best material available in this country. There is, however, a very important difference between the proposed Provincial Civil Services and the Provincial P. W. Branches; namely, that whilst a certain proportion of the higher appointments, now specially reserved to the Covenanted Civil Service, are to be thrown open to the former, apparently the entire control and direction of Public Works, and the construction of every work of importance and interest, is to be exclusively reserved for the Imperial Engineers. In other words, whilst the status of what is now called the Subordinate Executive Service is to be immensely improved, that of Engineers appointed in India is to be greatly lowered. If the suggestions of the Committee be acted on, the result can scarcely fail to be that as all the more promising young men educated in India and seeking Government employ will be attracted to those services which offer the best chances of advancement, the competition for employment on Public Works will be restricted to the less promising youths who see no other career open to them. We trust that this grave mistake will be remedied, and that the Provincial P. W. Branches will be so organized as to give those entering them a fair prospect of advancement.

We further notice that although the numbers in the Public Works Department will be greatly reduced in the future, there will be four different classes of officers in it, namely, Imperial Engineers, Provincial Engineers, Upper Subordinates and Lower Subordinates, instead of three as at present, and it is a question which deserves consideration, whether this is a desirable arrangement. We are ourselves inclined to the opinion that if the Engineer Establishment be divided into two branches, it would be advisable to abolish the Upper Subordinate

Establishment altogether, and to fill the more important posts now held by men of that rank by Provincial Engineers, and the less important ones by the senior members of what is now the Lower Subordinate Establishment. The great objection to this would be that it would provide no suitable positions for Military Subordinates; but as Military Subordinates are now almost exclusively employed in the Military Works Department, the difficulty could easily be got over by entirely separating Military Works from the Public Works Department, and the organization of the two Departments might then vary and be adapted to what was most suitable to each.

The abolition of the Upper Subordinate Establishment would be desirable for another reason. At present, at Roorkee, Seebpore and other Colleges, the first few men obtain appointments in the Engineer Establishment, whilst the remainder are offered posts as Upper Subordinates; the result is, that it frequently occurs that of two men of equal birth and education, and who have undergone exactly the same training, and have been friends and class fellows at College; one is appointed to be an Engineer and the other becomes a Subordinate, because he happens to have scored a few marks less in the examinations, occupying a totally different social position, and with no opportunity of rising out of it. It would be much the same if at Sandhurst the first few were given commissions and the remainder became non-commissioned officers. This is a state of things that ought to be looked into and altered at once, and we are not a little surprised that it was not noticed by the Commission.

In a future issue we propose to return to the subject and consider the proposed Imperial Engineer Service.

HALF HOUR WITH INDIAN FINANCES.

IF a candid confession is good for the soul we are bound to admit that Mr. Westland's remarkably able and lucid paper on the salt and petroleum duties, followed by the Appropriation Report on the accounts of 1886-87, and the usual formality of the Financial Budget must have operated as a relief to the Government of India. The peculiar circumstances under which the administration of a country like this is carried on, leaves no room to the authorities to halt between two courses. Hostile criticism on the one hand and apologies for the policy of Government on the other make it imperative that the true state of affairs should be annually disclosed to the public, to avoid any misapprehensions on the subject. We have been placed face to face with facts with which we have been familiarised for years past. It is the old old story of the complications on the North-Western Frontier necessitating a permanent increase of military strength in that quarter, with strategic railways and military frontier works, constituting a permanent addition to the burdens of the State. The fall in exchange comes in for a share of notice, as well as the annexation of Burma. Provision was made for all these contingencies by an extra outlay of two millions and a half, but the expedients resorted to proved delusive and all calculations were upset by Burma proving a heavy drag on the

resources of the State and a further fall in the rate of exchange which resulted in a revised estimate of 1886-87.

Going into details we find that the amount usually provided under the head of Famine Relief and Insurance is Rs. 15,00,000. In the year under review, however, the amount was reduced to Rs. 13,61,300, the difference being due, as stated in the Financial Statement, to a deduction on account of "the interest payable during construction to the Company which has undertaken the construction of the Indian Midland line." In the revised estimate the grant was limited to Rs. 3,11,900, and this is about the actual expenditure. From a general statement of the revenue accounts, we find that in 1886-87 the gross earnings of State Railways (Rs. 1,08,29,000), Guaranteed Railways (Rs. 72,80,500), Subsidised Companies, &c. made a total of Rs. 1,81,11,100, while the expenditure on the same account was Rs. 1,12,04,100, Rs. 79,56,100, and Rs. 45,200 respectively; and Miscellaneous Rs. 94,400, giving a total of Rs. 1,92,99,800. From the above it will be seen that the State Railways did worse than in 1885-86 by Rs. 7,70,000, and the Guaranteed Railways better by Rs. 3,07,700. This has resulted by the transfer of the Sindh, Punjab and Delhi line from the Guaranteed to the State Railway Head, and the opening out of new lines as in the Southern Mahratta and Burma systems. Allowance being made for these complications, the deficiency in State Railways is caused by excess payments under interest and annuities in purchase of Guaranteed Railways amounting to Rs. 5,89,300 and Rs. 3,53,700 respectively, and exchange Rs. 3,79,300.

On the other hand, the gross earnings of State Railways amounted to Rs. 8,70,100 more in 1885-86, the working charges and surplus profits having increased by Rs. 3,17,800; the collections on account of irrigation exceeded those of 1885-86 by Rs. 68,400, and the budget by Rs. 35,100. The increase is shown in the Punjab and is due to the opening of the Sirhind Canal and the development of irrigation from the Bari Doab Canal, as well as the realization of arrears of revenue in that Province. Except in this instance, the direct receipts from Imperial irrigation works are inconsiderable. In Provincial works, the net revenue in 1886-87 was Rs. 20,300 less than that of previous year, owing, not to a falling off in the total amount of gross revenue, but to an increase in the working expenses, such as by repairs to the Mahanuddee weir of the Orissa Canals, damaged by the cyclone of 1886. Under the head Irrigation expenditure it was much the same as in the previous year, but fell short of the budget allotment, as owing to urgent demands for jails and other civil works in Burma the grants for irrigation had to be cut down.

The outlay in Imperial works in the year under review exceeded that in 1885-86 by Rs. 20,100; in Provincial and Local works the outlay for the same period being Rs. 74,300 less than in 1885-86. The difference in the receipts for buildings and roads between 1885-86 and 1886-87 is due to the recovery in the latter year of Rs. 1,50,000 on account of the rendition of the Gwalior Fort and Morar Cantonment to His Highness the late Maharajah Scindiah. Turning now to the Post Office, Telegraph and Mint we find that

the receipts shewn in the Budget for all these departments was estimated at Rs. 19,14,100, in the revised budget for 1886-87 Rs. 19,76,700, and under the head of accounts Rs. 20,27,500, while the expenditure under the same heads was Rs. 22,27,500, Rs. 21,71,800, and Rs. 21,45,300 respectively. The Post Office worked up to the estimate of the year, and the Telegraph Department shewed a deficit of Rs. 21,700 only; whereas according to the estimate it might have shewn Rs. 2,04,000. This result was obtained by increase in receipts as well as by economy in expenditure. The Mint shews the most satisfactory results. Although there was curtailment in expenditure the efficiency of the work turned out was maintained as usual.

A MODEL GOVERNMENT.

A QUEER, abnormal *Imperium in Imperio* is that of the Andaman and Nicobar Islands. But it is not without appropriate dignities, and for one of them has its yearly Administration Report, like other Imperial satrapies. The one for 1886-87 is decidedly more interesting reading than such records of self-complacent progress usually are. The Andaman's Government, like all the rest of us, has been suffering from financial pressure. The usual P. W. D. grant was therefore cut down Rs. 5,000 and there was difficulty even in finding funds "to cover the heavy annual expense of earth-oiling the many wooden buildings of a permanent nature in the Settlement."

However, the estimated value of local raw materials, and of what we should call in India Jail Manufactures, mounted up to the respectable sum of Rs. 46,800, and in spite of inability to oil its buildings the Department had virtually Rs. 85,079 to spend for other objects than bunds, jetties, sea-walls, etc., on which, thanks to convict labor, no actual cash need be expended.

Besides bunds, jetties and sea-walls it would appear that roads, bridges, tanks and wells are the Engineering works in demand. And then there are buildings *pucka* and *kutchra*. And there are always a lot of repairs needful in such a storm-beaten, cyclone-subject locality. On Viper Island there are workshops for convict blacksmiths, carpenters, tinkers, tanners, cobblers, carvers, brass finishers, canoe makers, and a dozen more miscellaneous branches of trade. Last year the Artificer Corps numbered 577 efficient. All the bread stuff needed for the Settlement is ground at the Commissariat Steam Mills. There were three saw mills at work, and as a result of their working a goodly number of padouk telegraph posts and tea boxes, and sundry planks, squares, and sleepers were exported to Calcutta and London and appear to have been in fair demand. Besides this export trade there was some local consumption, and although the saw mill books shewed a deficit when debited with suppositional cost of convict labor, it has to be remembered that they are only in their infancy as yet. Better things are expected of them.

Broadly speaking, the Andamans are all forest, the clearances only amounting to 25 square miles out of 2,000. Mr. Carter, the Deputy Conservator, says that practically the

whole area of clothed forest may be regarded as a reserve, since clearings can only be made under the authority of the Superintendent. The aborigines do not clear land. Living as they do almost entirely upon fish and wild pig they do not care to. Grazing rights cannot accrue, since the forest growth is so dense that cattle cannot penetrate it. For general protection there is no need for up-keep of a forest staff even. Forest fires do not occur. The Andaman forests are, in short, or ought to be at any rate, Departmental Utopias. The existing padouk trees in the forests are supposed to be at least 300 years old. For the last three centuries that is to say, there has been no natural reproduction of padouk. Other species, such as the Bomba and Payan, have taken possession of the blanks left by fallen kings of the forest. Half the padouk trees standing now are hollow and useless, and the experiments hitherto undertaken in order to encourage natural reproduction are *not* encouraging. At Danikhari, 10,000 plants of the dani palm have been planted out. Bamboos are growing well from seed obtained from Burma. The profit on the working of the Department for the year was Rs. 5,579-14-2. Elephants are employed to drag the felled timber through the forests and the outturn is entirely dependent on the number of elephants available for this work. It is costly carriage, a heavy item of departmental expenditure, emigrant elephants at the Andamans being peculiarly liable to a disease of the feet, which incapacitates them from labor for long periods at a time, and kills them off very often. In view of this misfortune Mr. Carter suggests that if the Department can see its way to developing a sufficiently remunerative trade in timber, some sort of portable tramway should be brought into requisition.

The Report concludes with an appreciative notice of the Topographical Survey of the Nicobar islands conducted by Colonel Strahan. Although the interior of the islands has been left unexplored in most cases, each island has been carefully traversed round the whole extent of coast line, and in this particular the maps may, we are assured, "be trusted as being perfectly accurate." Latitudes for the purpose of checking the coast traverses were measured at seven stations, and longitudes at three. The heights of conspicuous points were determined. The more important rivers of the great Nicobar were explored and mapped, as far as boats could proceed along them. The point on which the geographical position of the whole group depends, is marked by a large masonry pillar, over which a wooden observatory has been built. And so forth. The Survey party discovered some good well-sheltered anchorages along the east coast of Great Nicobar, notably at Tenlaa, Campbell Bay and Matait-Anla. The southern coast of Little Andaman was also surveyed by Colonel Strahan's party, and is to be connected with the northern coast by a prismatic compass survey made by Mr. Portman. In short, not to go further into detail, the Scientific Department of the Andaman Island's Government did its duty energetically, as indeed everyone in any way associated with the conduct of affairs in that demagogue-unhindered offshoot of India seems to have done.

Notes and Comments.

RANGOON DRAINAGE PROJECT.—The Shone System is making progress. The pipes are already being laid from the works on Monkey Point Road.

DERAILMENTS.—The attempts to wreck trains in various parts of India have been too frequent of late. The matter demands the consideration of Government.

THE TRANS-CASPIAN RAILWAY.—The extension of the Trans-Caspian Railway from the Oxus to Bokhara and Samarkand is reported to be complete as far as Khwaja-Daulat, a place half-way between Charjui and Karakul.

PUNJAB NEWS.—Orders have been issued for the commencing of work on the Patiala-Bhatinda Railway. This is a broad gauge line, going to be constructed under the Department Provincial Public Works at the expense of Patiala State.

CEYLON RAILWAY LOCO-DEPARTMENT.—Mr. Trevethick has taken his departure for Japan to take up the important post for which he has been selected in that country. Mr. A. E. Brown is to act as the head of the Locomotive branch of the Railway of the Colony.

PROPOSED RAILWAY IN SIAM.—The ultimate aim of the promoters is that the line shall be carried across the Siam boundary through the British Shan States to the Chinese frontier, and they hope to make it a means of opening up a great trade with South-West China.

MALLADA-TAMPARA PROJECT, GANJAM.—This project provides for constructing an anicut across the Korakoryaur two miles above its junction with the Rushikulya, improving the existing channels and excavating new ones and embanking the Tampara or natural lagoon. The estimate, which amounts to Rs. 30,700, is under consideration.

THE DACCA CYCLONE.—The recent tornado at Dacca was of very small diameter, but extremely destructive. The wind force far surpassed the record. Solid masonry was cut through; *pucca* houses overturned, and terraced roofs blown away. The whole area affected was comparatively small; but the damage done has been estimated at 10 lakhs of rupees.

THE OUDH AND ROHILKUND RAILWAY.—Above two or three hundred officials met in the Locomotive Office at Charbagh, Lucknow, on the morning of the 2nd instant, for the purpose of presenting a farewell address to Lieutenant-Colonel J. H. Jenkins, late Agent of the Oudh and Rohilkund Railway Company. The address was read by Mr. H. B. Hederstedt, the Chief Engineer to the Company.

THE VICTORIA DOCK.—The sea gate of the Bombay Victoria Dock was opened for the first time on the 3rd instant in the presence of a few gentlemen connected with the Port Trust of Bombay. It is now something like a month since the dock has been brought into use through the channel of communication it has with the Prince's Dock. The event marks the practical completion of this dock.

DEPARTURE OF THE CHIEF ENGINEER, W. I. P. RAILWAY.—Friday, the 16th March, was an eventful day in Mormugao, in connection with the W. I. P. Railway. Mr. E. E. Sawyer, the Chief Engineer and Agent, having accomplished the task of the construction of the line, left the service of the Company, and a large gathering assembled, consisting of the staff, subordinates of the railway, and other friends and visitors, to bid him farewell and a safe return home.

A NOTEWORTHY ILLUSTRATION.—The holders of fields irrigated by the Sone Canals are exchanging their annual leases for five-years' leases, simply because the latter give the lease-holders the first claim on the available supply of water. This growing readiness on the part of the people to bind themselves to pay cesses for five years is strong proof of trustful intelligence, because the amount of water required from the irrigation channels year after year is not fixed, but depends on the rainfall.

FRONTIER RAILWAY EXTENSION IN THE HOUSE.—Sir U. Kay Shuttleworth asked for an assurance that the Government had no intention of pushing the Quetta Railway to Candahar. Sir James Fergusson in replying stated that the frontier railways were well within our frontier, and that there was no intention to go beyond it, nor was there the slightest idea in strengthening the frontier of expressing distrust in the good faith or honesty of intention of any other country.

WANTED—P. W. D. RE-ORGANIZATION IN CHINA.—Fear is entertained that the repair of the breach of the Yellow River cannot be completed before the time of the spring floods, and that most of the fertile parts of the province of Honan will remain a lake. It is stated that a French syndicate of Engineers, now at Tientsin, have engaged to close the great breach in the Hoang-ho, and have also tendered to keep the river under control for thirty years for the sum of 30,000,000 taels.

KIDDERPORE DOCK-WORKS.—Judging by the progress already made, and allowing for delays, it is confidently hoped that the docks will be ready to receive ships early in 1891. There are, at present, upwards of 11,000 men employed, whose health is very fair, the death-rate for the past 12 months having averaged only 475 per 1,000. Very many of them live on the land, and they are all liberally supplied with filtered water, which, it may be safely averred, has more than half to do with the healthiness of the people.

ITEMS FROM SINGAPORE.—The Secretary of State has been pleased to confirm the leave of absence for eight months and fourteen days on half-salary, granted to Captain M. A. Cameron, R.E., Deputy Colonial Engineer, Penang.—H. E. the Governor, with the approval of the Secretary of State, has been pleased to appoint A. Rowe, Esq., to be Government Engineer Surveyor and Examiner, Singapore.—Sir Andrew Clarke has returned from Bankol to Singapore on his way home, after having personally inspected the routes of four proposed railways in Siam territory.

THE ABT RAILWAY SYSTEM.—A Quetta telegram says:—During the past week there has been a trial of the Abt system on the two miles of line which have been completed. The system did not stand the tests satisfactorily; and it is not unlikely that the idea of having the Abt system from Mach to the Katal will be entirely given up. The Abt system does not work well on curves, and the engines can only climb hills provided that their heads are kept straight. Perhaps the engines and materials collected at Hirok will be utilized at the Kojak.

PENNER ANICUT, NELLORE.—Completion estimates for the Penner anicut system, including provision for the improvements required for rendering the existing works more efficient, were sanctioned by the Secretary of State in April 1885, to the extent of Rs. 16,12,789, of which amount Rs. 15,04,250 had been expended up to 1886-87. The grant for last official year was Rs. 40,000, and for this

is Rs. 50,000. This system is estimated to irrigate 69,385 acres on the south of the Pennér, and the ultimate net return anticipated is 7 per cent. on the total direct and indirect outlay.

THE HYDERABAD DECCAN COMPANY.—The following telegram has been received from the Agent of the Hyderabad Deccan Company, Limited, dated Secunderabad, 12th March 1888:—"Hughes reports confirmation gold Raichore; several old workings; surveys being made. Rough washings indicate very good show gold." The agent asks for stamp heads, &c., to be sent out. Mr. Hughes's deputation with the Company will cease on the 15th May, and speculation is rife as to whether he will retire from the Survey with which he has been nominally connected of late years.

FOREST TRAMWAYS IN SOUTHERN INDIA.—The Madras Government is about to introduce the system of portable forest tramways at once into the forests of South Coimbatore, and are obtaining, through the Secretary of State for India, enough material to lay down seven miles of tramway as a beginning. The total cost of importing the plant and laying it down in the forests is estimated at half a lakh of rupees. Lieutenant-Colonel J. C. Walker, Conservator of Forests, Southern Circle, Madras, who is at present on leave at home, will select the material from Messrs. Fowler and Co.

THE HYDERABAD RAIPUR EXTENSION.—A Conference has been held at the Residency, Hyderabad, regarding the proposed railway extension to Raipur. Sir Charles Elliott, Mr. Howell, Mr. Furnivall, Colonel Marshall, Mr. G. Forbes, Mr. White, Nawabs Mohsin-ul-Mulk, Sirdar Diler-ul-Mulk, Intesar Jung and Azim Yar Jung, and Mr. Watts were present. It was, the *Deccan Times* hears, unanimously decided that the scheme could only be taken up if the shareholders consented to the reduction of the guarantee from 5 to 4 per cent., as stated in the original proposal. It is therefore doubtful if the project will be carried out.

EXPENSIVE EXPERTS.—Mr. Barrington Brown, the Geologist sent out by the Secretary of State for India, to report on the Ruby Mines in Upper Burmah, receives it is stated, a salary of £200 per mensem during his engagement, which is at present for six months, and to have all his *bonâ fide* travelling expenses paid by the Government. It is said that Mr. Theodore Hughes, of the Indian Geological Survey, draws something like the same figure during his deputation with the Hyderabad-Deccan Company. We are not aware whether Mr. Bruce Foote drew anything extra for his flying prospect of the Mysore Gold Fields.

INDIAN TIDAL OPERATIONS.—The work of tidal observations, to which we have referred on a previous occasion, and which has been for many years regularly carried out by the Indian Survey Department in this country, is now to be systematically taken up in England, and the British Association has lately appointed a Committee of three experts to prepare the ground by drawing up instructions for the practical part of the work. The members are Professor G. H. Darwin, Sir William Thompson and Major Baird, R.E., who had been in charge of the Tidal Observations here from the time of their commencement until quite recently.

IRRIGATION OPERATIONS IN THE N.-W. P. AND OUDH.—The total outlay on canals in the united Provinces for 1886-87 was Rs. 19,09,628, or Rs. 3,31,191 more than in the previous year, due to the construction of the new Nadrai aqueduct on the Lower Ganges Canal, and the

extension and completion of the distributary system on the Agra Canal. The actual income realized from all sources was Rs. 57,17,108. After paying all expenses, including all interest charges, the net revenue was Rs. 4,11,643, against Rs. 2,67,071 in 1885-86. Excluding the Betwa Canal the gross income was Rs. 56,96,408, the total charges Rs. 50,78,820, and the net revenue Rs. 6,17,588.

ROORKEE COLLEGE EXAMINATIONS FOR 1888.—The Report of the Thomason Civil Engineering College for the past year shews the year to have been a satisfactory collegiate one. In the Engineer Class, of the 2nd year students, Mr. Perry (St. Paul's School, Darjeeling) heads the List, and besides taking a Certificate as Assistant Engineer, he carries off the "Thomason Gold Medal" for the best Engineering Design, and Prizes for Civil Engineering, Experimental Science, Surveying and Drawing. Mr. Eaglesome (Mussoorie School) is second on the List, and takes the "Higher" Certificate as Assistant Engineer, the Council of India Prize of Rs. 1,000, the Cautley Gold Medal for Mathematics, and a prize for Photography.

SAMALKOT-TUNI CANAL, GODAVARI.—The extension of the (high level) Samalkot canal to Tuni on the borders of the district was proposed by Major (now Major-General) Cotton. Its length would be 37 miles. Major Cotton's quantities at the rates of 1877 amounted to Rs. 4,00,000. The Local Fund Board agreed to contribute one-third of the estimated cost. The project has only been partly investigated. The canal will have to cross the Yellera river not by an aqueduct, but by a weir with floodgates on either side of the river. Colonel J. O. Hasted, R.E., has placed on record that, should this project be taken up again, it must be considered whether a tidal canal would not be preferable to this canal, which it might be difficult to supply.

SEAWATER FOR TOWN ROADS.—As far as we are aware Madras is the only town where the advantages of utilising seawater for watering roads and streets are availed of in India. Turning seawater to account in the way mentioned has come into use in Colombo. It has not met with adequate encouragement in many localities where facilities exist. At Colombo, for instance, seawater is extensively used for the purpose, without giving rise to objection of any moment. In drouthy weather especially, it has proved very handy and serviceable. This utilisation is nothing new. It has already been put to the test in several English cities on the seashore. The satisfactory results achieved in these cases strongly plead for a fair trial in other places favorable for the purpose.

"INDIAN ENGINEERING."—We have received the last number for March, of *INDIAN ENGINEERING*, an excellently got-up illustrated weekly Journal, devoted to the profession and its interests, and edited by Mr. Pat. Doyle, C.E. Mr. Doyle is perhaps better known in Madras than in Calcutta; for it was in the capital of the Southern Presidency that he distinguished himself as an accomplished mathematician, and a thoroughly practical Engineer. The success of his Journal, which has now been more than a year in existence, is sufficient proof of the professional ability of its Editor, and his praiseworthy perseverance against competition. The Journal is equal in matter and letter press to any of its kind in England, and reflects credit on the printer and publisher, Mr. C. J. A. Pritchard.—*Poona Observer*.

A STEAM TRAMWAY.—The firm of Messrs. John Fowler and Co., the great narrow-gauge railway plant manufac-

turers of Leeds, have offered to construct a steam tramway 2ft. 6in. gauge, between Nandgaon G. I. P., station and Aurungabad. The cost of the line and rolling stock, construction, etc., will be about 14 lakhs, of which they undertake to provide 10 lakhs by floating an Indian Company to be registered under the Indian Companies Act in Bombay. They require the balance of 4 lakhs to be contributed by H. H. the Nizam's Government—not all at once, but in four instalments of a lakh each, upon the completion of each fourth station of the railway. This sum of four lakhs will be a bonus to the Company, in return for which they require no guarantee from H. H.'s Government as regards any fixed dividends.

THE HUKONG VALLEY.—The net result of the exploration party's efforts is, that a practicable path for road or rail has been found from the Brahmaputra to the Irrawaddy, in length say 300 miles. The greater part of the country through which the rail would pass is totally uninhabited. The mineral products of the country are gold, silver, platinum, amber and jade, salt and coal. The gold has been dug for, and the mines well worked at different times on the banks of the Kamdu and Namkwum. The platinum and silver mines would be about twenty miles north of the line of rail, amber and jade mines lie in the east of the Hukong Valley, and are about ten miles off the route. The wealth of this small valley between the Chindwin and the Irrawaddy is undoubted, and is a valuable acquisition for us.

IRRIGATION IN MADRAS.—In the year 1886-87 the total revenue assessed on irrigated lands in Madras was nearly 230 lakhs of rupees, of which some 170 lakhs were due to irrigation and the remainder to land revenue. Some five million acres of land were occupied for irrigation during the year, nearly four and three-quarter millions of which were irrigated in the first, and rather less than one million in the second crop: the total area of land which bore irrigated crops was over five and a half millions of acres. The larger systems, which derive their supply of water from the great rivers, have cost rather more than 500 lakhs of rupees to construct. These include among their number the one black sheep of the flock, the Kurnool Canal. The net profits in 1886-87 on the entire capital were 5.9 per cent. We purpose going more fully into the Report in an early issue.

THE PROPOSED NEW TOWN HALL AND MUNICIPAL OFFICES FOR BOMBAY.—The report of the Committee of the Corporation appointed to consider the proposal to purchase the Cathedral High School and add to it contains the following suggestions:—(1). That the present proposal regarding the Cathedral High School be rejected. (2). The appointment of a small committee of experts to revise the schedule of requirements, &c., and to give an approximate estimate of cost. (3). A limited competition of selected architects. (4). An open space round the Municipal buildings. The committee reiterate their opinion that the sum to the credit of the building fund is wholly inadequate, and to express their opinion that if the Corporation be not now prepared to erect an office and hall, that will be a beauty to the city, they had better take no further steps at present, but allow the building fund to accumulate at interest, rather than waste it on an insufficient and unsatisfactory building.

CANALS IN BENGAL.—The canal system of Bengal is an important source of revenue, as much when utilized for navigation as when used to irrigate fields. The Orissa,

the Midnapur, and the Sone Canals are used both for irrigation and for navigation; while Hidgelle Tidal Canals, the Orissa Coast Canal, and the Calcutta and Eastern Canals serve for navigation only. The last-named is the most remunerative system of navigation canals in India, and yields a net return of more than five per cent. on the capital cost. The revenue in the last official year, from navigation only, on all the six canal works just named, amounted to nearly eight lakhs, and that did not include what was received from Government transport services. The value of the merchandise carried on the canals was 778 lakhs of rupees, and the value of the crops irrigated was 93 lakhs. In addition to the canals, navigation is maintained on the Nuddea rivers by the Public Works Department, and the revenue from that source last year was two lakhs.

LORD DUFFERIN ON TECHNICAL EDUCATION.—Referring to the proposal to establish a local School of Arts and Industries at Lucknow, the Viceroy observed on a recent public occasion in that city:—I have always taken the deepest interest in technical education. I have called the attention of all the Subordinate Governments to the desirability of promoting this branch of instruction by every means in their power; but I must remind you that it is neither within the competence nor the functions of the Supreme Government to give practical effect to its views. The latter responsibility devolves upon the Local Governments in a certain degree, but still more largely on the various Indian communities. Even the Local Governments unassisted by the liberality and counsels of those who are in a position to support their efforts, can do but little. You, at all events, in contributing no less than five lakhs to this most noble and practical mode of meeting the needs, embarrassment, and wants of modern Indian civilization deserve the highest praise.

THE MADRAS GOVERNMENT MINERALOGIST.—The Madras Government having called upon Mr. Bruce Foote, of the Geological Survey of India, to examine and report upon the work being carried out by Mr. Bosworth Smith, their Mineralogist, at Burgor, in the Salem district, that officer has now reported very favorably on the operations made in this locality in regard to two old native gold workings, and has suggested that, as he considered Mr. Smith's powers of observations and his knowledge of rocks and minerals were of a high order, he be called upon to work out the geology of the crystalline rocks of the Presidency which cannot be reached by the present Geological Survey of India, and to draw a map of the area of auriferous tracts of country still unknown to the mining public. The Governor in Council, in considering these proposals, has decided that Mr. Smith should not be kept longer, after the expiry of his present agreement, than will allow of his completing his report upon the operations upon which he has been engaged, and of his rearrangement of the mineral collection at the Central Museum.

SINGARENI COAL FOR MADRAS.—The line of Railway from Singareni to Bezwada is likely to be open for traffic about June, and the long-expected supply from the Singareni coalfields should, it is expected, be then available for the Madras and South Indian Railways. The *Madras Mail* calculates that the coal can be put on to the trucks at Singareni at a cost of about Rs. 3 per ton, as the conditions of mining are very favorable, and that it will cost about Rs. 2 per ton to transport it the

seventy miles into Bezwada, and to put it into the boats for carriage down the Kistna and Buckingham Canals. The distance from Bezwada to Madras by canal is about 250 miles, and as water carriage is notoriously cheap, we are probably well over the mark in estimating the cost of carriage for this distance at Rs. 5 per ton, which is about 4 pies per ton per mile. It would seem, then, that the coal could be laid down in Madras city at a cost not exceeding Rs. 10 per ton, as against Rs. 15 to Rs. 20 which is the price of the English coal now in the market. We view these expectations differently, and time will tell.

ANAMALANKA PROJECT, GODAVARI.—This project comprises the construction of a tank or reservoir, storage capacity 4,420 millions of cubic feet, length $7\frac{1}{2}$ miles, greatest width $4\frac{1}{2}$ miles and area $9\frac{1}{2}$ square miles, near the ruined village of Anamalanka in the Yernagudem taluk. It is 6 miles north of Nallacheri, a large village on the trunk road between Ellore and Rajahmundry. The site is feverish in wet weather. It will be supplied from the Yerracalva, a perennial river which gets its principal supply from the south-west monsoon and is said to be valuable when the north-east monsoon fails. The reservoir has been proposed to act as a flood moderator to the drainage of the Yerracalva which enters the western section of the Godavari delta under the Nandamur aqueduct at the head of the Ellore canal and has several times endangered the safety of some of the delta canals. The reservoir is intended to irrigate 45,000 acres and also at times to supplement the supply of the delta canals. The estimates for the project prepared in 1873 amounted to Rs. 8,14,000, excluding land compensation, which was subsequently ascertained to amount to Rs. 77,800, making a total of Rs. 8,91,800 for works. The estimates are said to require revision, but further investigation has been deferred till the Godavari delta works have been completed.

THE CALCUTTA AND BOMBAY MINTS.—A Government Resolution has been passed on the working of the Calcutta and the Bombay Mints. The net imports of gold into India in 1886-87 amount to Rs. 2,17,70,652, against Rs. 2,76,29,347 in the previous year. No gold was coined in either Mint. In Calcutta, the gold was valued at Rs. 92,686, consisting entirely of bazar bar gold. In the Bombay Mint, the stock of gold at the beginning of last year represented a value of Rs. 4,602. No gold was tendered for coinage by the public. The net imports of silver into India and coinage in both Mints from 1872-73 to 1886-87 were a total of 9,230 lakhs in imports and 9,102 lakhs in coinage. The amount of defaced and uncurrent coin remitted to the Calcutta Mint for recoinage was Rs. 11,37,424. In Bombay Mint, the amount of uncurrent coin received for recoinage was three and a quarter lakhs. The loss on recoinage operations amounted to Rs. 13,125 in Calcutta, and Rs. 3,081 in Bombay. Last year the silver tendered in the Calcutta Mint for recoinage through the Currency Department was valued at Rs. 1,59,82,723, and in the Bombay Mint Rs. 3,46,18,702, of which Rs. 51,31,296 were returned to Calcutta for coinage. The coinage copper amounted to Rs. 11,71,289 in 1886-87. The gain of copper coinage in both Mints last year was Rs. 7,67,040. The operative losses in Calcutta and Bombay during the year were Rs. 23,849 and Rs. 21,447. The total revenue from both Mints during the last five years is less than the total expenditure during that period by Rs. 26,41,499. This gives an average annual loss at Calcutta of five lakhs.

Current News.

SANCTION has been given to the extension of the Morvi State Railway from Vankaneer to Rajkote.

THE town of Colgong, in the Bhagalpur district, was almost entirely destroyed by a great fire last week.

THE funds that were collected in Cawnpur for a Jubilee memorial are to be expended upon a public park for Cawnpur.

CAPTAIN LINDSAY, R.E., proceeds to Darjeeling to provide huts for the accommodation of the troops returning from Sikkim.

COLONEL CONWAY GORDON, after the conclusion of the business that took him to Hyderabad, is expected in Lahore on the 18th.

IT is stated that Sir Charles Elliott has pronounced against the new Railway scheme submitted to the Hyderabad Government by the Nawab Diler Jung.

ACCORDING to Lloyds' Register of British and Foreign Shipping List of 20th February, Captain J. Donnan has been appointed ship and engine surveyor at Colombo.

AT about midnight, on Monday last, a most destructive fire broke out at the Goosery Jute Mills, causing damages to the extent of about two lakhs of rupees.

THE new Government House at Simla is nearly finished, but it will not be ready for occupation for, at least, a month or two yet, and it is doubtful whether the present Viceroy will reside in it.

THE India General Steam Navigation Company have given orders to Messrs. Bow, MacLachlan and Co., of Paisley, to construct two twin screw engines for their steamers employed in the Calcutta trade.

MR. J. ELIOT, Officiating Meteorological Reporter to the Government of India, leaves Calcutta for Simla to-morrow. Mr. Blanford, who has taken an extension of three months' leave, will probably not return to India.

ARRANGEMENTS have been made for the immediate survey of the Ahiri Forest Reserves in the Central Provinces being undertaken by the Forest Survey Branch simultaneously with the survey of the forests in the Raipur district.

MAJOR-GENERAL J. H. M. SHAW-STEWART, R.E., late Consulting Engineer for Railways to the Government of Madras, and also one of Chief Kolar Concessionaires, has been appointed Chairman of the Cape Town and Suburban Railway Company.

THE Meteorological Department of the Government of India has just published a volume of Charts of the Arabian Sea and the adjacent portion of the North Indian Ocean, shewing the mean pressure, winds, and currents in each month of the year.

THE India Office has directed that all demands for botanical information and for seeds from the Royal Gardens at Kew should be made to the Government Botanical Gardens at Saharanpur through the Botanical authorities at Calcutta, Madras, or Bombay.

DEPUTY SURGEON-GENERAL J. SHORTT has just published an interesting monograph on the cocoanut palm, dedicated to Surgeon-General Edward Balfour, the author of the "Cyclopædia of India." It is illustrated with some excellent photo-etchings, the work of the Survey Office at Calcutta.

THE British India Company have just given an order to Messrs. A. and J. Ingles, of Pointhouse, Glasgow, to build two steel screw steamers of 4,000 tons each; the engines are to be of the triple expansion type, and the horse-power will be about 2,000. The steamers are intended for the coasting trade.

IN order that the completion of the palace at Simla for the occupation of Lord and Lady Dufferin may be pushed on, Mr. Irvine has been instructed to devote himself specially to it. All other works will, it is believed, be under the charge of Mr. J. W. Wright, Superintending Engineer, Umballa.

THE new Town Hall at Jounpore, a magnificent structure, built by Messrs. T. H. Smith and Company, of Allahabad, was opened last week by Mr. Lawrence, Commissioner of the Allahabad Division. The ceremony was an imposing one, as all the native notables of the surrounding districts were present.

THE Ooregum Gold Mining Company, having spent £7,000 of borrowed money on the development of its mine, is now raising £30,000 by 10 per cent. debentures, repayable at the expiration of five years with a bonus of 25 per cent. On the 14th February the average yield at six points of the mine was over 4 ozs. of gold per ton of quartz.

THE derailment of the engine of a goods train between Pindi and Golra on the 28th March was not due to a defect in the permanent way as was first supposed, but to the breakage of

the axle of a pair of tender wheels. No fears need, therefore, be entertained as to the security of that part of the North-Western Railway permanent way.

THE Victoria Jubilee Institute Building, the foundation stone of which was laid on the 16th February last year, by Colonel LeGeyt, Political Superintendent, to commemorate the Jubilee year of Her Majesty the Queen-Empress, and in which is located the Palanpur Native General Library, was opened on the morning of 3rd April under a salute of 31 guns.

DURING the late storm which raged at Rawal Pindi some of the wagons and carriages at the Railway Station were blown away, causing slight damage to the rolling stock. A roof of one of the camp houses of the Northumberland Fusiliers' camp at Rawal Pindi was also blown off on to the Railway line near Sohau, but was discovered in time to prevent damage to passing trains.

WE are sorry to report the sudden death of Rao Saheb Hiralal Maekhal Nazar, Assistant Engineer, P. W. D., of Thana, at Agra. The deceased served long and faithfully in the department, rising from the lowest grade to a responsible and respectable position. He was in charge of harbour defences in Bombay for a long time. Rao Saheb Hiralal was on the eve of retiring on a well earned pension.

THE Sea Front of Madras will be greatly enhanced in beauty when the public buildings now in course of erection are completed. The foundation of the Small Cause Court, on the site of the old Abercrombie Battery, is being laid under the Superintendence of Mr. J. H. Stephens, and the High Court Buildings will shortly be taken in hand. The buildings of Lippert and Co. are also being thoroughly cemented and extended.

THE Government of India in the Public Works Department has sanctioned an expenditure of Rs. 19,000 to put into a thorough state of repair the line of telegraph between Bassein and Diamond Island. This was one of the recommendations of the Court which sat last year to enquire into the loss of the *Sir John Lawrence*, and was a point on which much stress was laid. Another of their recommendations—to connect the Andamans with the mainland by cable—has unfortunately not commended itself to Government, owing to the large expenditure it would involve.

THE Kolhapur Industrial Exhibition was opened on 2nd April by Colonel Hunter, C.B., C.S.I., Acting Political Agent, in the presence of a large number of native Chiefs and gentlemen, and European residents of the station. The idea originated with Mr. Candy, and all the arrangements were carried out by Mr. Shannon, the popular Executive Engineer, and his assistants. Their united efforts were crowned with great success. The exhibits which were sent in from all parts of the Southern Mahratta Country include specimens of art manufacture, machinery, agricultural implements, &c.

PRACTICALLY no progress has been made during the past cold-weather with the fortified *serai* at Lundi Kotal, the most important strategical position in the Khyber. All work, never very much at the best, was stopped some weeks ago, for want of funds we believe; and it is doubtful if anything will now be done till next winter. The effect of this sudden collapse of our efforts to strengthen ourselves on the Khyber line of communications is likely to be a very bad one among the local tribesmen; for the Amir's officials have circulated a rumor that the work has been abandoned in consequence of the remonstrances of their master.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

THE OVERSEER DEPARTMENT OF SEEBPORE ENGINEERING COLLEGE.

SIR,—Anybody who is fully acquainted with the misfortunes and hardships which have assailed the last batch of Christian students of the Overseer class in the procuring of suitable appointments cannot help but fully sympathise with them. These men received their College certificates last February, and up to the present, whether for want of interest on the part of their late superiors, or the inability of the latter to give any help, or mis-directed prejudice on the part of employers, not a man has anything to do worth mentioning beyond two who were employed for something over a month in the fitting up of a steamer belonging to the Indian Marine Department for Burma. When the late Mr. Charles Fourcres, was Superintendent of the Seebpore Workshops, it is well worth remarking that through his agency few of his men were without employment for any appreciable length of time, and they are now all holding respectable employments. But now these very sort of men, what with being handicapped with Roorkee Overseers, and with pecuniary difficulties falling in the way of making shifts for themselves, are not in the most agreeable predicament.

Can anything be more disheartening than after five long years of a good and substantial training, to meet at the end of it such a miserable result?—to say nothing of what must be the feelings of a newly joined student, who cannot help but

be convicted with the idea that his College course is but a highway to a yawning abyss rather than a faithful reward of labor conscientiously done. Roorkee men, on the other hand, after a couple of years of, one cannot help but think, "cramping" (during which time they are bolstered up with every encouragement,) and one of apprenticeship, are promiscuously distributed into all the vacancies available, and there is reason to believe, that when the demand for men has been excessive in Burma, even those who have not completed their three years' course have been sent.

This is a most earnest appeal to those executive authorities it may concern, in fairness to the Seebpore students, to give the latter a trial of few months, and see if they cannot work side by side with Roorkee favorites, and prove themselves quite up to the mark.

FAIR PLAY.

THE MADRAS PUBLIC WASTE DEPARTMENT—IRRIGATION BRANCH.

SIR,—It is not my intention to enter minutely into an examination of that curious record.—*viz.* Administration Report of the Public Works Department, Irrigation Branch, in the Madras Presidency, for the year 1886-87. As usual, the document contains an immense amount of figured statements and details with little or no progress, the absence of which is accounted for by the usual pleas of "want of funds," delays on the part of the Revenue authorities, unfavourable seasons, &c., &c. Such pleas have now become so chronic that it is scarcely worth while writing about them.

My object at present is to point out how a large and important work like the Godavari Anicut is dealt with, as this is a matter of general public interest, the project having originally been designed to show how important it is to have the irrigation of a district properly attended to in the interests of the Government and the people, as well as to avert the danger of famine and losses. At page 7, statement No. II., I find that upwards of 563,621 acres are irrigated by this Irrigation work, yielding a revenue of Rs. 18,36,938. The full water-rate of Rs. 4 per annum should have yielded Rs. 22,54,484, but no explanation is given why this was not realized. The water-supply being most abundant, surely when a loss of some 18 per cent. occurs, the point of short fall in revenue requires to be looked into. We are then told that Rs. 1,22,787 must be deducted as the share due to old Irrigation; and then, in column 6, we come to the most astounding of all the facts we have ever seen, *viz.*, that the share of enhanced value of land is Rs. 1,61,005, when it had been shown just before that these works of irrigation had created a seventeen-fold increase of Revenue from the land over and above what the old irrigation yielded!! As the charges under one head and another made against the works are now 49 per cent. of the revenue as it is collected, it is no wonder to us they show a net percentage of only 11 per cent. on capital, particularly when a loss of 18 per cent. of revenue or above 4 lakhs is left quite unnoticed.

In this statement, too, the cost of the waste and mis-management of the Kurnool works is added, and exhibited in such a way as to show most unfavorably against properly designed hydraulic works, like those in the delta districts. This is most misleading. I have neither time nor inclination to look further into this record; every statement in it is equally unsatisfactory. For instance, at pages 96-97, we find in one place the estimated value of cargoes for the Godavari Canals to be Rs. 1,22,33,392, and in the next page it is Rs. 1,25,33,511, plus apparently Rs. 1,24,79,802 belonging to private individuals! I can give your readers no explanation of such figures beyond informing them that the officer * now in charge of the Godavari works was specially selected for the duty on his own recommendation and trumpeted as being infinitely superior to Sir A. Cotton, or any of those whom that officer recommended; and under this distinguished individual the progress of the works has fallen off more than 50 per cent., whilst the charges against them have been largely enhanced.

I would notice one point more. The annual license fee for cargo boats is Rs. 2-8-0 per ton, an increase of 150 per cent. The revenue obtained by this is only Rs. 86,893, and its cost of collection, &c., is Rs. 66,892, or 76½ per cent. on the Godavari. So that at the same time that these Engineers lose 4 lakhs in irrigation, they maintain such a system as the above for revenue purposes. On the Kistna Canals, matters are far worse—total receipts being only Rs. 24,045 and the charges Rs. 91,406, a dead loss of over Rs. 67,000 a year; and it is from the Engineers who have advocated and established such gross mismanagement as this that the wise-acres of our Municipal Board, at the instance of the acting Resident, have decided to learn about our water-supply. I have pointed out these actual results for the benefit of our rate and tax-payers, in the hope they will at least step in to prevent such folly being perpetrated here at their expense—as upon them the consequences will remain.

J. F. F.

* If our Correspondent refers to Mr. G. T. Walsh, M. I. C. E., Superintending Engineer, No. 1 Circle, P. W. D., Madras, he is in error and at fault.—ED. I.E.

THE DISTRICT ENGINEER IN BENGAL.

SIR,—Your correspondent "Rational" in your issue of the 31st ultimo has described in very clear language the position of the District Engineers in the N.-W. P., but allow me to state for him, as well as the edification of the public, that his namesakes in Bengal are in a situation far more unpleasant than his. The disadvantages noticed by him apply with equal force to the case of the Bengal Engineer with the additional disadvantage that should he (the Bengal Engineer) chance to incur the displeasure of the District Board in the faithful performance of his duty, he is subject to be sent about his business without even the chance of an appeal to any higher authority. In the N.-W. P. all the District Engineers are members of the regular P. W. D., and as such have in cases of friction the great advantage of being either transferred to the regular line or to some other district, but the District Engineer in Bengal is a purely private servant entirely in the hands of a body of masters, who as a chameleon, change color so often that the unfortunate Engineer is always in a puzzle to chalk out his course.

Before the introduction of the "Local Sluff" in Bengal, matters were in a more satisfactory footing, and the Engineer could do his work more smoothly under the late Road Cess Committee, but the new Act in Bengal has been framed in a way which pretends to ignore the importance of the District Engineer, and the rules have conferred such arbitrary powers on the so-called "Finance Committee" that they sit under the cool shade of the punkah to criticise the Engineer's work without possessing in the least degree an iota of professional training, much less any knowledge of the difficulties he has to contend with. For the interests of the service, the Engineer should possess a certain amount of independence, otherwise his being roughly handled by his merciful masters, who always think of having performed a feat of chivalry if they can pass some disparaging remarks on him, lowers him in his own, as well as in the estimation of his subordinates. The power given by the new law to the District Board to reduce the District Engineer's salary at their will is a step which has already begun to work disastrous results; instances are not rare where the members of the Boards are not wanting in the display of a feeling of jealousy at the prosperity of their Engineer, because due to his professional attainments and hard work performed in the inclemencies of the weather, he happens to earn a few hundred rupees at the end of a month. It is now becoming a matter of every day occurrence that directly there happens to be a change in the appointment of the District Engineer, the salary is reduced. How far this is a move in the right direction experience will teach, but this much may be said with safety, that it is a false economy obtained at the sacrifice of efficiency. Good pay is always an incentive to good work. A half-starved D. E. will never be able to command the respect due to his position which is a matter of momentous importance in a Mofussil district, nor shall he be able to do justice to his work, being handicapped by pecuniary want.

The Local Government is too busy to look into these matters, and is furthermore bent upon shirking all connection with them, but it is following a most suicidal policy by losing sight of the fact that the District Engineer is an officer upon whom rests a great amount of trust and responsibility, and that he is an important element in the administration of the country. If matters do not take a better turn, i.e., if the Government do not consider worth its while to put a stop to the exercise of power by the District Boards dangerously affecting the status and prospects of these officers, before long there will be in the country a body of discontented public servants, who will work without any devotion to duty, and simply try to while away their time knowing that there is no one to appreciate their merit, nor is there any one whom they can look to for sympathy and support. True it is that in Bengal there is the Inspector of Local Works as the professional superior of the D. E., but that officer enjoys very little power calculated to improve his prospects; in fact, he comes to find fault with the D. E.'s work and not unfrequently forgets to notice his good qualities, and the result is that his inspection report, though meant in no way to the discredit of the D. E., when laid before the members of the Board places the D. E. in an awkward position, and costs him no small part of his time and thought in framing out a long explanation for the satisfaction of the masters of his fate.

Such is how matters are in Bengal with the unfortunate District Engineer, who in these hard times is compelled to subject himself to no end of ignominy under several masters for an honest livelihood, as the P. W. D. can no longer find room for him.

Trusting this letter will, for the interests of the profession, attract the sight of the P. W. D. potentates in the Writers' Buildings, who from their palatial seats are accustomed to see everything in their Subs as smooth as the fine terra-cotta which adorns the pavement they tread upon.

EXPERIENCE.

CALCUTTA MUNICIPAL CONSOLIDATION ACT.

SIR,—All interested in Municipal reform are recommended to study the new Calcutta Municipal Consolidation Act, which will shortly come into operation: to readers of your Journal, the sections 233—246 "of Building Regulations regarding houses" are especially deserving of attention.

The first clauses (sections 233 and 234) relate to dangerous structures and the powers of the Commissioners in dealing with them.

Section 235 requires a person intending to build, before doing so to submit site plan for sanction of the Commissioners, which is to be accorded within 30 days: one peculiar condition is that "such plan shall also shew the position and approximate height of all other masonry houses within 40 feet of the proposed site." How about always getting such information, and expressing it on the plan? We shall want professional isometric and perspective draftsmen! In sections 236, 237 and 238 it is laid down that the person intending to build shall serve the Commissioners with a notice to that effect on a printed form: such notice to state the objects, description, nature, details, &c., of the building: this is after approval of the site plan, and the Commissioners may decide within 30 days, unless it appears to them that further information is needed when their decision may be deferred for another 30 days—90 days in all! In these times of railway speed, and when every day's delay represents a calculable sum of money absolutely lost to the parties building! Further (listen to this, past Seebporites) plans, &c., may be rejected if not warranted by a competent surveyor. Here is an opening for independent and lucrative work.

Section 239 qualifies the above by notifying that the period of 90 days may be curtailed by submitting at the outset complete plans and information, &c., along with the site plan and requisite notice. It also requires the submission of fresh notice if the building operations have stood over for one year after the Commissioners shall have signified their approval. On the other hand, if the building shall have begun without such permission, the Commissioners may (sections 240—242) cause the same to be demolished, or may inflict a penalty.

The next section (243) is the most important section; by it the Commissioners are provided with large powers to regulate—

- (a.) The levels and widths of foundations.
- (b.) The lowest level on which a house may be built, to allow of drainage into sewers.
- (c.) The height of plinth—2 feet above centre of nearest road is fixed as a minimum.
- (d.) No building being erected over public drain or sewer.
- (e.) The position of privies.
- (f.) Adequate ventilation.
- (g.) Open spaces on any building site.

The loose and haphazard way in which these seven important features are referred to, without the slightest attempt to lay down fair lines on which the public could reckon with some confidence is quite too absurd. It cannot be imagined that any competent Engineer has scrutinized this section, and let it stand in its delightfully abstract form. A perusal of the English Metropolitan Building Act will shew at a glance that it is necessary for the protection of the public, and also to avoid vesting too much power of this kind in the Commissioners, so that the footings and widths, &c., of foundations, the quality of materials, thicknesses of walls, areas of windows for light and ventilations, heights of buildings, projections, the extent of open space for building sites, &c., are points which should be dealt with in order to set the whole thing on an equitable and yet on a popular basis.

What, for instance, is to be understood by 'plinth' in (c)? What absolute connection has it with the floor, which presumably it is intended to fix the level of? Who is to determine the adequate ventilation in (f), and who the extent of open space which is to be consistent with the free circulation of air?

The remaining sections refer to compensation for delay on the part of Commissioners, which is liberally fixed at Re. 1 per diem—a proof of the failure to grasp the extent to which private interests suffer by delay.

But section 243 is really too slipshod in its details: regulations of such importance to the public and to Government as well, through its Public Works Department, should have been most carefully and widely discussed; in fact, should have been officially referred to those who have had experience of building in Calcutta as well as to those whose daily work brings them face to face with the operations of the Municipal Act.

BUILDER.

MINE RENTS AND MINERAL ROYALTIES.—At the last monthly meeting of the Geological Society at Manchester, an interesting paper on the important question of mine rents and mineral royalties was read by Mr. C. M. Percy, M.E., F.G.S. The President, in introducing the reader, said that the question was of great importance. Mr. Percy had gone to the root of the matter, and some historical value would, no doubt, attach itself to the paper. Mr. Percy, observed that he had done his best to obtain the best historical evidence, but did not wish to lay claim to any infallibility, Mr. W. H. Barrett said he was sure they had all listened with the greatest interest to the paper. Mr. Percy had gone into the subject fully and discussed it from all its bearings. He would move a hearty vote of thanks to Mr. Percy. Mr. Hardwick seconded the vote. Mr. Percy in acknowledging it said it had given him great pleasure to prepare his paper. He could assure them it had been a labor of love, and their thanks were largely due to the President and to those gentlemen who had helped him in his task. He hoped the expression of the vote of thanks would endorse the view that he had simply treated the matter from a citizen's point of view.

General Articles.

THE GREAT INDIAN PENINSULA RAILWAY VICTORIA TERMINAL BUILDINGS, BOMBAY.

THIS week we give the principal elevation of the above buildings, and in our next issue we hope to give the plans. The buildings were commenced in 1879, and have been under the direct supervision of Mr. F. W. Stevens, F.R.I.B.A., A.M.I.C.E. Since that date various designs for the buildings were prepared and submitted to the Directors of the Company and Government from time to time, but none of them were approved until Mr. Stevens, at the special request of the Railway Company, was allowed by Government to prepare designs, and the result was the erection of the present buildings. We may mention that the design was exhibited at the Royal Academy London, in 1880, and had the honor of being placed on the *line* in the centre of the room devoted to architectural designs. The style of architecture adopted is the Italian Mediæval Gothic, which appears to be most suitable for this class of building. The principal façade has a length of 1,500ft. and forms one side of Hornby Road. On reference to the plan it will be seen, that the main building, or Administrative Offices, is in the shape of the letter **m**, *ie*, a centre and two wings with a quadrangle having a garden and fountain therein facing west. The north wing, upon which the station proper abuts, is occupied by the large Waiting Hall and Booking Offices. These are approached from the carriage porch through the groined entrance 42ft. in length by 11ft. in width and 22ft. in height, which is divided into four bays, each bay being groined domically in white Porebunder and red stone worked in a star pattern. The main ribs are richly carved and moulded and spring from the backs of grotesque animals at the angles. The moulded and carved cross and doorway arches are supported by red and grey polished Italian marble columns, beautifully marked, which are surmounted with richly carved Porebunder stone caps of varied design. The moulded bases and pedestals of columns are of Coorla buff-coloured stone. Access is given to the Hall by wide blue stone steps through four large doorways, each doorway being 8ft. in width. The doors are of French polished teakwood, panelled and moulded, and of massive design with brass mountings. The Hall and Booking Offices are 82ft. x 72ft. x 40ft. in height. On the south side it overlooks the garden which is tastefully laid out; on the north side are three large doorways, each 8ft. clear in width, giving the public access to the station platforms, and on the east side are entrances to the Refreshment and Ladies' Waiting Rooms, &c. In the centre of the Hall and at the sides are massive clusters of coloured marble columns surmounted by foliated carved stone caps of bold design, which carry the arches supporting the upper walls of the building, and the decorated groining forming the roof. Galleries 12 to 14ft. in width are placed round the Hall, which communicate with the Offices on first floor. The main ribs of the groining are emphasized by strong lines in red, blue, buff and gold, while the ground-work or space between the ribs is of azure blue with gold stars thereon. The carved pendants forming the keys to the ribs of the several groined bays are decorated in colours and gold to harmonize with the other work. The walls are lined to a height of 4ft. 6in. with Maw & Co.'s glazed tiles of foliated and geometrical design, and above this with Porebunder stone facing, having strongly marked joints in Portland cement. The floors are paved with ornamental unglazed tiles arranged in large panels. The tympana of windows are filled in with panels of coloured glass of varied design and low tints, the latter having the effect of subduing the glare and softening the light over the Hall, so essential in a tropical climate. The counters with their brass railings are constructed in the different local coloured woods by the East India Art

Manufacturing Company, from designs prepared by Mr. Stevens. The wrought-iron railing of the galleries and grilles of tympana of doors are decorated in chocolate, picked out in bright red and gold which harmonize with the other decorations. The remaining portion of the north wing is occupied by 1st and 2nd Class Waiting Rooms, Lavatories, &c. for Ladies, Station Masters' and Ticket Collectors' Offices, all of which are decorated in a simple, but appropriate manner. Adjoining the Waiting Rooms, and facing the garden on the west side, are situated the Refreshment Rooms. One has been set apart for 1st Class Passengers (52' 6" x 47') and the other for 2nd Class Passengers (47' x 24' 6"). The rich moulded arches of these rooms, which carry the main floors and walls of the building, are supported by massive polished Aberdeen granite columns of varied colours with bold caps of artistic design. The ceiling of the former room is richly panelled, moulded and carved, and decorated in two shades of cream and gold. The walls are painted a delicate subdued green above the dado, which is of Maw and Co.'s glazed tiles, rich in colour and bold in design. The floors are covered with ornamental tiles similar to those of the large Waiting Hall already described. The large circular counter is in coloured richly moulded and carved woods, French polished with a white marble top. The decorations of the 2nd Class Refreshment Room are more simple in character, but appropriate. The Gentlemen's Lavatories and conveniences are placed at the back of this wing and are divided from the main building by a wide covered space to insure thorough ventilation. The Lavatories, etc., are fitted with the most approved arrangements. The artistic furniture for the Station Rooms, which is in strict keeping with the other architectural embellishments, has been supplied by the East India Art Manufacturing Company. The remaining portion of the main building is occupied by the Administrative Offices, which we will now proceed to describe. In the centre of the building in the quadrangle is placed the principal entrance and grand staircase approached by a carriage porch from the garden. The arches under the porch are richly moulded and carved, and supported by massive clusters of red Aberdeen polished granite columns, capped with delicately carved Seoni stone caps. The entrances to the Hall and staircase have massive arches carved and moulded in rich design supported by massive piers and coloured marble columns. The doors are of teak, moulded, carved and French polished, with heavy brass hinges of bold design. The staircase is over-hanging and is 8ft. 6in. in width. It is constructed of blue local (trap) stone, each step being in one length about 12ft. with a 3ft. 6in. tail in wall; some of the winders are as much as 15ft. in length without a flaw. We hear that there was much difficulty and delay in getting these monolithic stones without flaws. The staircase forms the principal approach to all offices on the upper floors. It is covered by the large masonry dome, which will be described hereafter. The wrought-iron railing of staircase is of rich design and is decorated in chocolate, picked out with bright red and gold, having a moulded, French polished hand-rail. The newal is ornamented and massive in character, the shaft being of red Aberdeen polished granite surmounted by a richly carved cap. Above this in a sitting posture is a large lion carved in stone bearing a shield with the Company's arms thereon. The floors of Hall and staircase landings are paved with ornamental coloured tiles of artistic design. The galleries of staircase are supported on arches richly panelled, which are carried by massive moulded stone corbels of bold design. The large entrance doors with massive brass hinges and handles are of polished teak, moulded and carved somewhat similar to those of the Waiting Hall. The walls of the staircase are lined to a height of 4ft. 6in. with Sienna marble having a moulded dark marble top and base which forms a very rich and massive dado. Above the dado the walls are lined entirely



20
15
10
5

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with white Porebunder stone, the corners being emphasized by strong lines pointed in Portland cement. The moulded arches of all openings are supported by coloured marble columns with foliated caps of varied design. Above the 2nd floor the walls are transformed from a square into an octagon by means of "squitches" or arches thrown across at the angles, which are richly carved and moulded and form an important feature in this portion of the building. Just above these arches is a very massive carved cornice, which carries a gallery round the octagon. The parapet is composed of red coloured marble columns with caps, bases and coping of Porebunder stone. The gallery communicates through openings in the lower portion of the large windows under dome with the balconies outside, from which a magnificent view of Bombay and its harbour can be seen.

(To be continued.)

A MICROSCOPE ILLUMINATOR AND POLARIZER TO OBSERVE EXTREMELY MINUTE OBJECTS.

II.

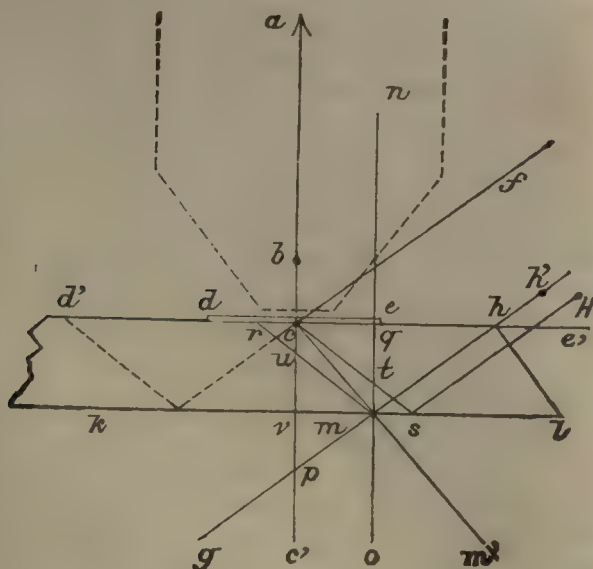
BY G. DUBERN.

SOLUTION.

WHILST keeping to conditions of No 3, Nos. 1 and 4 become opposed to each other, as one requires lighting in a normal to the plane of observation and the other at an angle to it. But polarisation of light as a means of analysing being so very important, its requirements prime the other, or at least, the other is to yield partly when impracticable to carry out both together.

A plain geometrical construction of elementary character is all that was needed to solve this problem of optics.

Fig. 1.



In *fig. 1* let $a b$ be the axial line of the microscope: c the object to be observed: $d e$ a cover over the object c : at c draw an angle $f c a$ equal to angle of polarisation of light ($54^{\circ} 35'$), then a parallel to $c f$ is the line on which the source of light must be placed, and a surface parallel to $d e$ is to be the reflecting plane illuminating c .

Produce $a b$ to c' ; draw an angle $c' c m'$ equal to $41^\circ 42'$; through any point m in $c m'$ draw $k l$ parallel to $d e$ also through m draw $n o$ parallel to $a b$ and $g h'$ parallel to $c f$; then, angle $n m h = a p m = a c f = 54^\circ 35'$. Produce $d e$ to d' and to c' and take $q r = q h$; join $r m$: hence

a luminous source at h' will light point r with polarized light. Through c draw cs parallel to rm and sH parallel to mh : consequently c may be lit by polarized light if the source of light be at H .

Now triangles cqt and mvu are equal, therefore angle $tcq = 90^\circ - 54^\circ 35' = 35^\circ 25'$; this being less than $48^\circ 12'$ the light along tc or sc will be totally reflected by the glass cover de . But for all this to apply the space between the planes de and ms should be filled by a solid transparent body; so that if the opposite parallel internal surface of a glass plate be used as reflecting planes, all the above last described requirements are practically realised, and therefore c is lit from h with polarized light. But none of that light which is not reflected or diffused by objects at c can emerge above the cover de . Therefore, also, none can enter into the microscope but the one actually needed.

No. 1 requirements have now to be looked to. The light from h on meeting the surface $d' e'$ of the glass plate at such very large angle of incidence would be reflected back into the air to a great extent, and so much less would reach c . Moreover, refraction would alter the angle at s and hinder polarization.

So it is plain enough that to remedy this and satisfy No. 1, the surface of the glass on which the ray of light impinges needs have HS as a normal to it, in order that both reflection and refraction may disappear. Therefore, by drawing a plane hl , normal to HS , all practical requirements are fulfilled.

There remains only to find what angle $s l h$ is, in order to enable opticians to manufacture this new illuminator.

It may be shown that triangles $m q h$ and $l h m$ are similar and that therefore angle $h l m = 54^\circ 35'$, or just the very angle of polarization of light by a glass surface.

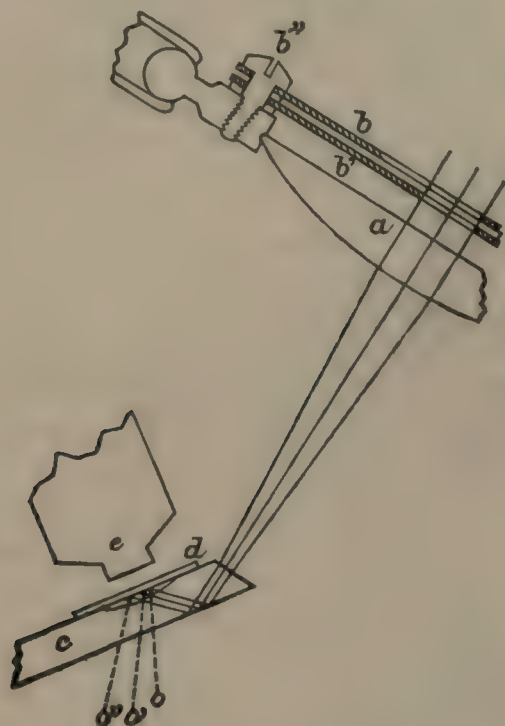
Finally, No. 2 conditions may now be taken up. It is plain that the greater the thickness of the glass, the longer will be the path of the light ray $e's$ and $s c$: so obviation of heat can be managed by diffusion in the substance of the glass. A half inch length of $e's + s c$ has been found to answer amply; so a glass plate a little over $\frac{1}{16}$ " is all that is needed: for the more volatile liquids, $\frac{1}{4}$ " answers better, and but little light is lost. If there be too much light and heat the fourth place of reflection at d' may be used instead of the second at c .

The second reflection of $\frac{1}{4}$ " thick glass plate is the more manageable to begin with and acquire practice. One soon sees into an unseen universe as through a most powerful telescope, though the power used be but 400 diameters. Seven and eight hundred are yet quite manageable, and for very special observations with the thinnest mica covers fifteen and sixteen hundred may also be used, say 1-12th of an inch objective. Such powers are quite sufficient in connection with the above illuminator, to unravel no end of mysteries, to make no end of discoveries, supplying the missing links to very many fragments of science apparently antagonistic, yet falling into harmony or forming one whole when seen to a sufficient extent.

It may here be quoted as an example of what may be expected from the searching powers of this style of microscopic observations, that the human blood corpuscle, *i.e.* (besides water), most of what composes human blood and described in standard authors on physiology as a *structureless framework* when in healthy condition, has been discovered through the help of this modest square inch of glass, not only to be composed of *from fourteen to sixteen life atoms, but also to be a genuine living animalcule.*

Moreover, the serum of healthy blood has been also discovered to be swarming, not with millions of single life atoms but with milliards of them. The bearing of these last two facts is of incalculable importance. Many of the most confused and contested points of physiology admit of decisive solution from the additional insight into the subject.

Fig. 2.



In fig. 2. are shewn the working dispositions based on the above described theoretical considerations. Except the light condenser, which is left natural size, other parts are on a larger scale than the actual ones.

a is the light condensing lens: b b' are diaphragms to regulate the amount of lighting: b has a $\frac{5}{8}$ " aperture and b' a $\frac{1}{8}$ " one: they are hinged at b'' so as to turn and uncover entirely the lens a if the most intense light and also some diffused light be needed: definition is best with the diaphragms. c is an ordinary cupped microscope object slide, cut off at about $\frac{1}{4}$ " from the edge of the cup, bevelled, ground and well polished at an angle of $54^{\circ} 35'$ to the under surface as described: d is the object cover; e is the object piece: o , o' , o'' are shewing three different positions of object,

o is illuminated by ascending polarized light: o' by both ascending and descending polarized light, i.e., it is lit top and bottom at the same time: o'' is lit by descending light only, namely, by the one reflected from the cover d .

The diameter of a is $1\frac{1}{4}$ ", with about $2\frac{1}{2}$ " focal length. The cupped glass may be used only for transparent or very nearly transparent liquids.

A plain glass slip with bevelled edge and a very thin layer of liquid pressed between it and a cover is the only successful way of observing milk, pus or such liquids diffusing much light and reproducing the ordinary way of lighting the field, though using the new style.

But if it be necessary to add a diluting fluid such as distilled water or glycerine, a preliminary examination of the liquid is necessary to provide against erroneous observations, as such addition is against the system of investigation advocated, it introducing foreign substances with their own world of life.

Fig. 3.



The arrangement is shewn in fig. 3.
(To be continued.)

ON THE CONSTRUCTION OF SEWERS IN MADRAS.

By HORMUSJI NOWROJI, B.C.E.,

Assistant Engineer, Madras Drainage Works.

II.

Physical Features.—The level of the ground along the line of the sewers varies between 26'00 and 33'00 or 6 to 13 feet above mean sea-level.

The greater portion of the sewers rest on sandy beds. But that portion of sewer No. 1 in Popham's Broadway, and a smaller portion of sewer No. 2 in Wall Tax Road, rest on a bed of what apparently is made earth. The reason for this is that the sites on which Popham's Broadway and Wall Tax Road now stand, especially the former, must have been at one time considerably below their present level. It is thought that Popham's Broadway may once have been the bed of an arm of the Cooum. In excavating for the sewer here, the soil met with was as bad as possible. In several places, the lower part of the trench was actually dug out with buckets, and men engaged on the works sank into the slush until their knees were down to the sill of the sewer. The soil below this semi-fluid stuff was good sand, as usual.

Subsoil Water-Level.—The level of the subsoil water is comparatively high. Water is found at all places within a few feet of the ground. Being close to the sea, the level of subsoil water may be assumed to be the same as the mean sea-level, i.e., 20'00 above datum. During the driest months, this level falls slightly below mean sea-level, but during monsoon, it is considerably higher.

Structure of Sewers.—Sewers of 12-inch and 18-inch diameters consist of pipes. Sewers above these sizes are constructed with brickwork.

A man can just crawl through a 24-inch sewer which enables the inside of the sewer to be plastered and finished properly. It is therefore not desirable to use pipes for sewers above 18 inches in diameter. These latter have the advantage of affording rapid construction. But they are liable to be cracked more easily under ground than brick sewers. Their greatest disadvantage is felt when they have to be laid on a yielding bed. A line of pipes is made up of short lengths of two feet connected by joints, whose resistance to transverse strain is only a fractional part of what it would be were the pipe continuous. It is a common and obvious theorem that no combination can be stronger than its weakest parts. As long as the pressure against the pipes is equal from all directions, it is capable of resisting the pressure. But when the pressure is uneven, or when there is a settlement of soil, however slight, the pipes yield at the joints. Brick sewers on account of their continuity are better able to withstand settlement of soil and uneven pressure. In slushy soil the massiveness of brick sewers offers greater resistance to a tendency to settlement than a slender line of pipes. Masonry sewers are also cheaper in cost. A pipe sewer 18 inches in diameter costs almost as much as a 24-inch brick sewer.

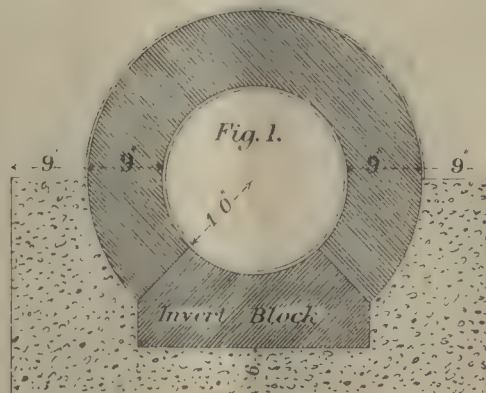
Difficulties in Construction.—The deepest portions of the sewers are 20 feet below ground level and 8 feet below permanent level of saturation. The disadvantageous nature of the soil already described, and the high subsoil level tended to increase the difficulties in construction, to enhance the cost and to make progress slow.

Excavation and Timbering of Trenches.—The construction of the sewers was commenced from their lowest point. The trenches required close timbering and careful attention. The excavation was opened and timbered in the following manner. The surface of the ground was broken to a breadth of 12 feet, and the excavation carried down to the depth of 5 feet, to which depth the sides of the trench stand vertically without slipping. Waling pieces A A are placed along the two sides of the trench at a distance of $3\frac{1}{2}$ feet from the ground, and are support-

DRAINAGE OF BLACK TOWN MADRAS.

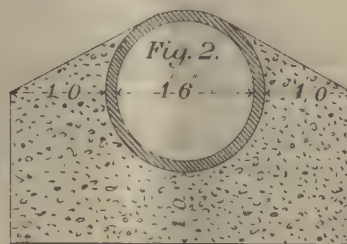
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Section of Brick Sewer



Section of Pipe Sewer

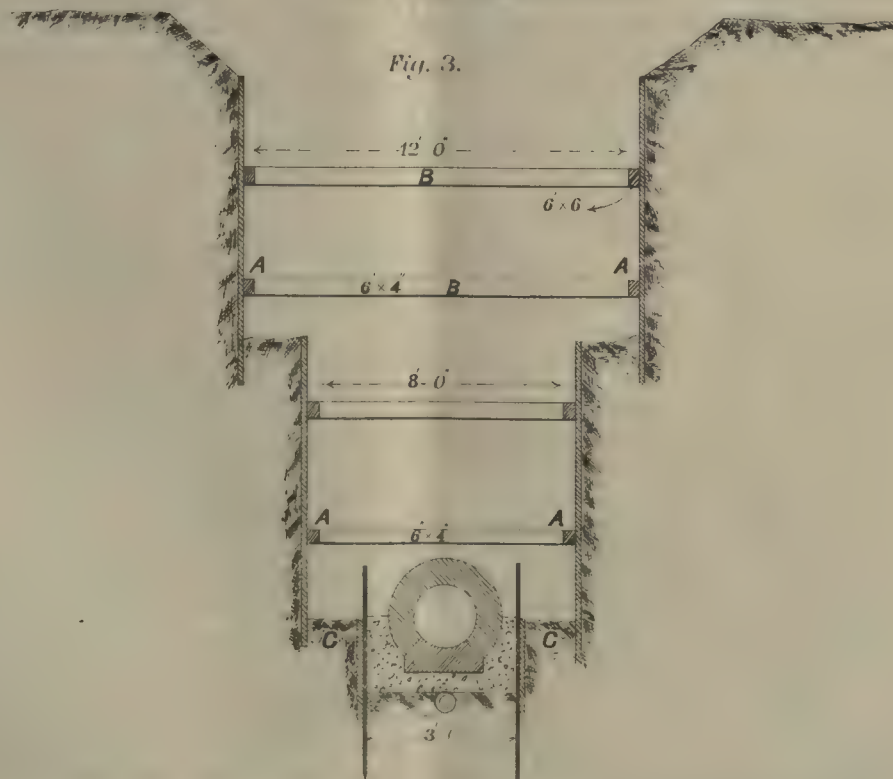
Scale 2 feet = 1 Inch.



Section of trench for Sewer

Shewing timbering

Scale 6 feet = 1 Inch.



ed there temporarily by cross-pieces of wood let into the excavation. Struts B are placed with their ends butting against the waling pieces, at intervals of 5 or 6 feet. A hole is dug out at the bottom of the trench just sufficient in width and depth to allow one plank to be slipped down behind the walings. After the insertion of the plank to its full depth, this hole is filled up and another dug for a second plank. Similar operations are being carried on on the other side of the trench. The slight gaps between the sides of the trench and the planking are filled up with loose earth well worked into the crevices. This operation presses the planks and waling pieces lightly against the struts, which are secured by wedges where necessary, making the whole timbering compact and steady. A second row of walings and struts is adjusted 3 feet below the top row. Finally the earth between the second row of struts and the end of the planks is removed and the trench deepened gradually, as far as the planks could be driven by blows from mallets. Below this, the trench is narrowed to a width of 9 feet and similarly timbered. Where trenches were deeper than 20 feet even with two rows of sheeting planks, the requisite depth was not reached, and the lowest depths had to be timbered by planks laid edge on edge and kept in their place by crowbars 10 feet long driven into the soil. Much difficulty was encountered in preventing the springs rising between the joints of the planks and at C, and forcing up the sand. Heavy packing with straw was found necessary.

For pipe sewers, the timbered trenches were made only 5 feet wide.

Sheeting planks consisted of mango wood, 10 feet in length, 2 inches in thickness, and in breadth varying from 12 to 18 inches. Waling pieces and struts were made of teakwood 6" x 4". Waling pieces were in convenient lengths not exceeding 20 feet. Struts were cut to the required lengths, and the ends shod with iron hoops to prevent splitting.

(To be continued.)

PROPERTIES OF FLUIDS.

BY A. EWBANK.

IX.

If to any one unaccustomed to the study of forces we put the question—mention some one quality of a body which you consider unchangeable he might reply as follows: "The temperature of a body is certainly not unchangeable. In fact, it is one of the most variable qualities. Nor is the shape unchangeable, for by a great pressure—or it may be by a heavy blow—we may certainly cause some alteration in the shape. But the *weight* of the body is an unchangeable quantity. You may by pressure very greatly alter the figure of a body, or you may by heat change it to a liquid, or you may perhaps by blows reduce it to a powder. But the weight of the body persists unaltered through these and all other transformations."

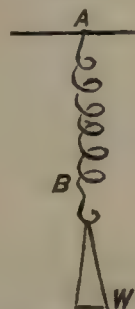
If it were objected that the body left long enough exposed to sun and air might dry or wither and so become lighter, he would at once point out that in this case some of the particles of the body had really been removed. "What you weigh," he would say, "when you weigh a dried-up, or withered body is only a part of what you formerly weighed when the body was unwithered. And what you now weigh has the same weight as what it had originally. That is, the still remaining particles of the body have the same total weight as had those identical particles when they formed a portion of a larger and so a heavier body. And if you could capture and collect those particles, which in the withering process have disappeared, these collectively would give you the missing weights. Thus what I said was that the sum total of all the weights of those particles that make up the whole body is an unchangeable quantity.

This reasoning at first sight seems irreproachable, but in reality it is fallacious. The weight of a body is not unchangeable. In fact, there is no such thing as *the* weight of a body. There is such a thing as *a* weight of a body, and this weight, like the weather, is variable. The weight of a body is nothing *in* the body, *i.e.*, it is nothing intrinsic to the body. It is something extrinsic—it is something outside the body. Suppose we have a mass of iron resting on a horizontal floor. To it we may attach a string; and may thus pull it along the floor. The pull on the body—caused by the string—is nothing intrinsic to the body. It is a force—an accidental force—outside the body. Such also is the weight of a body. It is a force—an accidental force—acting on the body from some cause outside the body. Take up this body from the floor on which it rests and carry it to some distant part of the earth. The body itself is not changed, but probably its weight is no longer what it was. Its weight has possibly become greater or it may have become less. Take that body to another planet its weight may be half of what it was here, or its weight may be considerably increased. What then is meant by the weight of a body? To answer this question we will state it in a different manner. The question may be expressed as follows: How shall we measure the true weight of a body?

Now, here it must be noticed that the ordinary balance may fail to give us true indications of the weight. For suppose we place twenty rupees in one scale of a balance—*i.e.*, a true balance—and in the other scale place a lump of iron so as to counterbalance the rupees. After this has been done suppose a man—unknown to us—scoops out from the rupees some of their silver, puts in a less costly metal instead, and re-engraves the coins so that the change may not be visible to the eye. It is possible that the substituted metal may be lighter than the silver. If so, suppose the man to scoop out some of the iron in the counterpoise and to fill up its place by a lighter substance. Then when we come to reweigh the rupees we shall believe they have not lost weight.

It will perhaps be said that these suppositions are unreal, or that they are "unpractical." But this lightening of the weight in each scale is exactly what does happen in certain cases. In the latitude of Calcutta the rupees have a certain weight and the counterbalancing lump of iron has exactly the same weight. If on taking the rupees to some place on the equator they are found to have lost in *real* weight, the mass of iron will have lost in precisely the same proportion. Consequently the iron and the rupees will continue to balance in the scales, and we shall never from repeated weighings be likely to guess that the weights themselves have changed.

Fig. 13.

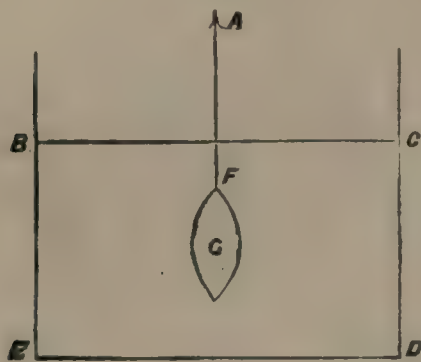


Therefore, in order to weigh bodies, we will suppose that we have contrived a different kind of weighing machine. Suppose we have what is sometimes called a spring balance. This is composed of a spiral A B of steel. See fig. 13. When a weight W is attached, the spiral lengthens and from the elongation we may judge of the magnitude of W to a close approximation. Provided with such a balance, and with some given mass W of iron, we may travel over the world, and may weigh our mass W at Calcutta, Rome, Paris, London and St. Petersburg. We shall then find that our mass of iron is continually

getting heavier. The iron itself is not changed, but that force which we call the weight of the iron is certainly changed. Thus we have no right to speak of the weight of a body, unless we assume that the body is only to be weighed at some one place of the earth's surface.

Even if we assume that the body we weigh does not change its latitude or its longitude, there is still another cause of error of which most people are unconscious. We remember how the mer-folk at the bottom of an ocean were disposed to consider that oil is a body of intrinsic lightness. The real fact is that one cubic inch of oil weighs less than one cubic inch of water. Bodies lighter than water must, like corks in water, ascend. These bodies the mer-folk might describe as having negative weights. Such an expression, if they invented it, would be strictly accurate or suitable. We on dry land are liable to mistake the weight of a body in the same kind of way as did the mer-folk. We ordinarily weigh our masses in air, they ordinarily weigh their masses in water. They see no weight in a body which weighs less than its own volume of water. We see no weight in a body which weighs less than its own volume of air. If we afterwards learn to reason that even such bodies as hydrogen gas may have weight—it is because we have formed a more scientific conception of weight than the uneducated land-man or mer-man is likely to possess.

Fig. 14.



Whenever we endeavour by a spring balance to estimate the weight of a body we under-estimate the true weight, provided we are weighing the body in the air. If now we hold the spring balance over water and let the mass of iron—or other substance—sink beneath the water till its further progress is checked by the spiral spring, then we are said to weigh the body in water. If we do so we shall have a result markedly different from what we obtained when we weighed the body in the air. To make this point clear let us consult *fig. 14*. B C D E is a vessel containing water. G is itself a part of this water. To help us to think of the mass G as distinct from the rest of the water, we imagine G to be surrounded with a film or shell or envelope. This film may be as thin and weak as we please, for there is no strain upon it either tending to expand it or to compress it or to tear it or in any way to alter its shape. But we speak of a film because we wish to consider that a string F A is attached to it.

Now as the mass G of water is resting on a bed made for it by the surrounding water, we do not need any upward tension in the string F A to enable G to keep its place. The surrounding particles of water must be pressing on G and these pressures support G so that the string F A gives no assistance, or in other words its tension is zero. If we could, without disturbing the film round G, abstract all the inside water and could substitute some other liquid which had the same volume and the same weight, then this new liquid, which we may call L, would rest under the supporting influence of the same pressures round and outside G as acted when G was full of water. There would still be no tension in F A and the new mass G would remain at rest.

If instead of L we had a heavier liquid, say mercury, then we must introduce inside G, not an equal volume, but an equal weight. If we introduce an equal weight the volume of the mercury will be much less than that of G. There will then be a space inside G which is quite empty. We must in this case imagine the film to be stiff enough to resist an alteration of its shape by the outside pressures from the surrounding water, as these are no longer balanced by corresponding pressures from within. If the film is thus stiff or strong enough to keep its figure unchanged, we shall have a little mercury, say m in weight, at the bottom of the inside space G and the upper part of the G space will be a vacuum. The tension of F A is still zero. Now into that empty part of the G space add some more mercury. No matter how small the quantity x which we add we shall have the string F A exerting a tension upwards if A is fastened to some immovable object. Without the aid of such a tension the new body G would sink through the water till it reached the base D E of the vessel. If we add another quantity y of mercury to the inside space the tension of the string F A will be increased.

If finally we fill up the inside space with a weight $x+y+z$ of mercury, then we shall have in the string a tension of $x+y+z$. This quantity $x+y+z$ is not the weight of all the mercury in the vessel. There is also that quantity which first was added and which in weight equalled the water which had been removed from G. If therefore we suppose the film without weight—or if we imagine this film to be of some stuff just as heavy as water, and think only of what is inside the film—we may say that the upward tension of the string F A is equal to the weight of all the mercury that is inside G minus the weight of all the water that was originally inside G.

Now this string instead of being fastened to a nail or peg may be fastened to a spring balance like that in *fig. 13*. Then the spring balance—whose upper end is supported, *i.e.*, is immovable—will shew that it is carrying a weight $x+y+z$. This is the weight of a certain volume of mercury diminished by the weight of an equal volume of water. If this experiment was made in oil, the volume G being the same as before, we should have the spring balance shewing a weight equal to that of all the mercury diminished by the weight of an equal volume G of oil. Thus here the quantity we called $x+y+z$ would be greater than it was in the case of water, because the subtractive weight of oil would be less. If finally we measured the weight of the mercury, not in water nor in oil, but some much lighter fluid, we should have the volume of mercury G apparently heavier. For from the true weight of the mercury in volume G we should have to subtract a weight much less than we had for the volume G of water or of oil.

Air is a fluid much lighter than water. Therefore when we weigh mercury or any other body in air we do not get the real weight of the body, but a certain fictitious weight which depends on the weight of a certain volume G of air. Let a cubic foot of iron really weigh P ounces where P is a large number. Let a cubic foot of air weigh Q ounces where Q is less than 2; then in air the apparent weight of the iron will be $P-Q$ ounces.

Let us suppose that we could introduce our spring balance and a body M into a space free of air or of any other fluid. Then if we weigh M there, we should get what we have called its true weight. But this weight is only the true weight for that particular place on the earth. If we could similarly form a vacuum at some other part of the earth's surface and could there re-weigh our body M, we should get another "true" weight, and this would apply only to the new place where we did the weighing. The variation of the true weight by change of latitude is a matter which we need not study here. But that variation of the local weight which is due owing to the presence of the atmosphere is a point that the reader should endeavour to understand.

NOTES FROM HOME.

(From our own Correspondent.)

THE ninety-first volume of the Proceedings of the Institution of Civil Engineers, which has just been issued, contains in its 600 pages, besides the inaugural address of the President, Mr. G. B. Bruce, a valuable paper on "Accidents in Mines." This paper forms the second part of the subject, the first part being found in the preceding volume. Sir Frederick A. Abel, who is the author, here deals with the influence of coal dust in causing or intensifying explosions; the various forms of safety cartridges; lamps and their defects, and lastly with the various forms of electric glow lamps, including the relative advantages of primary and secondary battery lamps. Following this is a paper on Electrical Tramways with a description of the Bessbrook and Newry Tramway by Dr. Hopkinson. Apart from the electrical working of the line, an important and novel feature in this tramway is the use of waggons with flangeless wheels, so as to enable them to be used on ordinary roads. In the discussions following this paper, it was stated that the average cost of working a tramway by horses was 7 pence per car mile; by steam 6 pence; by compressed air $5\frac{1}{2}$ pence; by electricity, whether applied by continuous conductor or by storage batteries, $3\frac{1}{2}$ pence; so that the cost of working tramways by storage batteries as opposed to horses was exactly as 1 to 2. Next to this comes eleven other selected papers upon various subjects, many of which are copiously illustrated. The remaining 120 pages of the volume are occupied with usual abstracts of papers in foreign transactions and periodicals.

In the obituary notices is an account of the career of Sir Joseph Whitworth, forming a story of his many inventions. A portrait of Sir Joseph forms the frontispiece to the volume.

A paper was read at the last meeting of the Civil and Mechanical Engineers' Society on the Construction and use of the Hopper Dredger by Mr. A. C. Schonberg, in which the author described the history and development of this particular form of dredger since 1872, when the first was built. The advantages of the hopper dredger were then detailed. A hopper dredger of 1,300 tons capacity was described in detail. This vessel steamed out to Otago, New Zealand, where she was put to work to cut the bar. She dredged to 35 feet and it was found that she performed her work at 25 per cent. less cost per ton than is involved by the use of a stationary dredger and attendant barges. Another hopper dredger, "the B. D. No. I." for the Corporation of Bristol was also fully described. During a fair average of six weeks she picks up 50 cargoes, fills herself, carries her load 30 miles down the Bristol Channel, and is back again in her moorings in 10 hours, including detention in getting in and out of dock and stopping for the traffic in the river. This vessel is built of steel. She recently raised a stone $2\frac{1}{2}$ tons without damage to buckets or any part of the dredger. Descriptions of several other craft follow.

Mr. Haldane's paper on the Air of Buildings and Sewers, which has recently been issued in pamphlet form by the Sanitary Institute, contains some very remarkable results of experiments on the air of sewers. For, taking the average results of thirty-two specimens of sewer air at different times and places, he finds that the total number of micro-organisms per litre in the sewer air at a temperature of 54° Fahr. is 8.9 while in the outside air at the same temperature of 49° , there were 15.9. "Evidently," the author says "in some respects sewer air is one of the most free from micro-organisms anywhere in a town. It is in this respect twice as pure as outside air, in summer at any rate."

Anent this subject of sewer ventilation it may be mentioned that at the suggestion of Sir Robert Rawlinson, the Association of Municipal Engineers are now collecting evidence and are about to carry out experiments on sewer ventilation, and as probably there is not another technical body having such opportunities of carrying out and watching such experiments, their report on this great and complex subject will be of much practical value and importance.

The Builder recently gave an interesting account of the underpinning of the Yarmouth Town Hall, a critical and daring operation which is approaching completion. This building was erected in 1882; it measures 132 feet by 108 by 50 feet high to the parapet, with a clock tower 110 feet high, the whole weighing about 5,000 tons, costing £30,000. The subsoil upon which this block was built consisted of the ocean deposited gravel bank, 16 to 18 feet of ooze subsequently contributed by rivers, surmounted by 5 feet of made ground, into which the trenches were cut for the concrete foundations.

The river Yare and its quay are 70 feet distant. In November 1886 the first indication was given of failure, when the west front of the building went over a foot at its ends and 8 inches at its centre, and there were ugly fissures in it. An account is given of the mode adopted, cast-iron screw cylinders were driven inside and outside the main walls, screwed down into the ballast and then filled with concrete; girders were placed on these cylinders parallel with the walls, and cast-iron needles passed through the foundations, thus transferring the weight of the building from the unstable ground to the screw piles. By a system of bolts acting on these cross girders the sunken portions of the building have been lifted and the tower set right by raising its lower side.

Last week's *Engineer* gives an illustrated account of a high speed locomotive constructed from the designs of M. Estrade, a French Engineer. This engine was exhibited last year at Paris, and is, by the sanction of the French Government, about to be tried on one of the State Railways. It is carried on six driving wheels, $8' 3''$ in diameter. The cylinders are $1' 6\frac{1}{2}''$ and the length of stroke $2' 3\frac{1}{2}''$. The tender is also fitted with wheels $8' 3''$ diameter, and arranged so as to carry the greatest quantity of coal and water. The stock has been constructed to attain speeds of 77 to 80 miles an hour. A comparison is made between the diameters of the driving wheels and cylinders of the principal locomotives now in use and those of the Estrade engine. From this it appears that there is a jump from 7 feet, the largest diameter to Estrade's $8' 3''$. It will be remembered that large coupled wheels were tried years ago on the Great Western Railway and found not to answer.

MINING IN GREAT BRITAIN.

(From our own Correspondent.)

DIFFICULTIES are already occurring with the miners owing to the enforcement of the enactment of the Coal Mines Regulation relating to the use of explosives and safety lamps. Oddly enough, the miners punish their employers for desiring to secure their safety, and to comply with the law. Thus, at one colliery, the men have been on strike for four days, resisting the introduction of an improved form of safety lamp. In another case, they refuse to work with safety lamps, alleging that their use injured the eyes, &c., &c. Again, they object to carry out the clause applying to all mines, requiring that explosives "shall not be taken into the mine except in cartridges." Between the men who object to have their safety ensured, and the owner who is daily remonstrating against his colliery being worked at little or no profit, the position of some colliery managers is far from being a happy one.

It appears that the quartz of the Mawdach Valley of Merionethshire contains very little free gold, that it is chiefly found in a mineralized form compounded with blende, sulphuret of antimony, galena, &c., &c. The indications are at present most promising, but the promoters have not realized their hopes of producing 1 cwt. of gold before the middle of January. Great expectations are raised on account of the mining operations being directed by well known experienced Australian Engineers.

It is not generally known that salt water is a good extinguisher of fires, and forms an excellent substitute for the "hand grenades" which are so largely coming into use. Many fires would be prevented, if a barrel of salt water and two buckets were placed ready for use and marked "to be used in case of fire." The cask may be made more generally useful if fitted with trunnions and supported upon a pair of light wheels.

It appears that there are about 200 electric safety mining lamps in use in Welsh collieries. Their weight is about seven pounds, which is said not to be a serious disadvantage, although it would be desirable if a portable lamp could be made not exceeding four pounds, which would still be about double the weight of an ordinary safety mining lamp. The light is said to be equal at first to that of about 8 clanny lamps, and gradually diminishes, but at the end of ten hours it is said that it still yields more light than a single clanny lamp. It is urged that the men like them and do not object to their weight, but this is somewhat doubtful. Most of them are worked by secondary batteries, which are recharged by placing them in series upon a table, about sixty in a group. No figures are published as to the cost of maintenance, but judging from the cost of electric lighting upon the surface, it is certain that the cost will be more than that of ordinary safety lamps. As yet none of them are provided with any means of

ascertaining the presence of firedamp or carbonic acid gas, it is probable therefore that their use will not become general, unless they can be provided with an indicator which will form a constant means of ascertaining their presence. With such an appliance, the electric safety mining lamp, which is safe of itself, would be a means of safety by giving warning in the event of a dangerous accumulation of gases. Various arrangements have been suggested for such purposes, but as yet none of them have been found to be of any practical value.

A curious confirmation of the theory of the condensation of smoke by electricity occurred recently at Newport in Monmouthshire and Castlecomer in Kilkenny. A heavy dark cloud lay over Newport in the afternoon which was accompanied by partial darkness. This was broken up by a thunder-storm followed by a shower of black rain. The shower at Castlecomer fell a few hours later.

It appears very desirable that the duty on gold and silver plate should be repealed in the United Kingdom. Last year the amount realized was £30,756 on silver plate, and £22,117 on gold plate. If this duty of 1s. 6d. per ounce levied on silver were repealed, it appears highly probable that the consumption of silver for the manufacture of ornaments and domestic articles would be increased at least one hundred-fold. Electro-plate would be almost entirely replaced by silver goods which would be readily converted into cash, in any emergency. If the consumption were increased, it appears certain the price of silver would tend to rise, and any further fall would be prevented. This matter concerns India very seriously as affecting the value of the rupee.

The Hodbarrow Mining Company, whose mines are occasionally flooded by the sea and the waters of the river Duddon, are about to build an immense embankment, 1,000 yards long, at a cost of upwards of £50,000, in order to prevent future encroachments. These mines extend under the estuary of the Duddon river, and it is expected that the charges for pumping will be greatly reduced by the erection of this sea wall. The mines are chiefly overlaid by limestone, and are about 1,400 feet long and from 500 to 750 feet in width, the thickness varying up to 90 feet; one adjacent deposit is also being worked. The output of hematite from these mines in 1880 was 343,194 tons valued at £240,000.

NOTES FROM TENNASERIM.

(From our own Correspondent.)

THE weather is so hot now that I trust your readers will excuse me if my letter is exceedingly short, and the dust is really unbearable, though some of our roads are watered. We had H. M. S. *Algerine* in port for a fortnight, and this enlivened us up a bit. She left a few days ago, and now we have the Austrian corvette *Fausana*.

A start has been made with our church, or rather cathedral. The supply of bricks has been let out to a well-known firm, and they are to be made *ek dhum*. The building of the cathedral also I hear, has been undertaken by this firm, and it is to be hoped that operations will be commenced at once, so that the walls may be commenced during the rains, the best time for brickwork of any kind. About the Jubilee Park a committee is to sit and report on it in a few days. The local papers have taken up the matter, I so strongly urged in these letters; I mean the water-works that are so necessary for the town. The wells which are the only sources of supply are drying up now, and "where," asks the *Advertiser*, "are the people to get water from for the next month and a half of hot weather?" and echo answers "where?" The Civil Surgeon may do his best to improve sanitation, &c.; but he never can decrease the mortality that usually occurs during the hot weather, unless he insists on having the houses supplied with good potable water. In his Notes on the Sanitation of the town, which was lately published, he recommends the construction of water-works, but not forcibly enough I fancy to attract the attention of higher authorities than our Local Board. It is true this body is almost nigh on bankruptcy, but let them use the money they raise on the octroi in these works, or, as the *Advertiser* recommends, ask Government for a loan, as other Municipalities have. The Secretary of the Municipality, who is also Engineer, and the projector (the paper stated) of a scheme for watering the roads economically—such is the versatility of genius—can easily formulate another scheme for water-supply if the ones exhibited by Mr. Addis and the P. W. D. are too expensive. It was the Secretary, who, I believe, saved the Municipality some thousand odd rupees, through discovering some error in the matter of

"Slaughter house" fees; let him now save the poor! "Corinthees" from cholera in Mounjan. It would be a noble work and more lasting I am sure.

The Avayjee wharf is progressing apace, and it will not be long before it reaches completion, and let us hope perfection too, in the matter of answering requirements. A rock was discovered some 50 feet from the main wharf, when it was first completed, but such a discovery need not be apprehended for the Avayjee one, as it is built on the best site afforded by the river, and moreover has been used from times of old. Our citizen soldiers have been inspected and passed muster, the Artillery went through the ordeal first and then the rifles.

The Strand Road, hitherto maintained by the Municipality, has been made over to the Port authorities, and it is expected that it will be kept in better order than before, as being much in the position of an only child it is most likely to receive all that fostering care and attention that is usual to such privileged things. The extension of this road, however, is not to be done at present; must wait till better times come, or till "hard times come no more." We are expecting our mangoe showers, and it would be a blessing, indeed, if they came, for the heat is, in the day, unbearable. A great deal of discussion has been going on in England, I learn, about the mangoe weevil, but the learned lecturer fails to tell us how to prevent the insect attacking the fruit. There is no doubt that the insect gets into the flower, and allows the mangoe to grow all round, and over him, as it were, and only finds its exit when the fruit is cut for eating; for I have often been grievously disappointed myself at dessert; but what I should like to know is how to prevent its making its abode there. People in Burma, however, do not care much for the mangoe after tasting the "Durian," that indigenous fruit of the Tennaserim; but I beg to dissent from this consensus of opinion, in favor of it. To me, a most repulsive appearance it has, and as for the smell—why the less I say about it the better. I was once prevailed upon to taste the fruit, and I'll never forget this weakness as long as I live. It had the taste of custard and putrid onions, and it took me fully a week to get myself purified. I'll send you one to Calcutta if you like this season.

Our Tonghoo-Mandalay Railway is making great progress. The two Supervisors, whom you report as having resigned, may well do so, the hard work they have is but little to their taste, and after all they are but young "uns," who soon give in. *In re* Martaban-Shwaygheen Railway, nothing further has as yet transpired. Mr. Dawson's small line of railway at Thatone has been inspected by the Manager of the Burma State Railway, and favorably reported on. The use of wooden sleepers in lieu of the steel ones is advocated, and if the line is to pay (which Mr. Riggs doubts at present) reduction of establishment is recommended.

Moulmain.

DEXTER.

NOTES FROM MADRAS.

(From our own Correspondent.)

WE have been having a little wild dissipation in the shape of a Fine Arts Exhibition since I last wrote to you. As usual, we have shewn that there is a great deal more in us than our most intimate enemies suspected, for I can tell you the show was a big thing. There were one hundred and nine oil-paintings, one hundred and eleven water-colors, etchings and photographs, and sixty-three miscellaneous articles. There were over a hundred exhibitors, many, if not most (it is too hot to analyze the catalogue) of whom were ladies; and I must do them the justice to say that I think they made the best part of the show. It was surprising to discover how many quiet, unassuming people there are among us who can not only draw pictures, but paint them afterwards—people whom you would have thought could hardly draw an inference. But that is our form. *Facta non verba* is our motto. Not but that we can talk too, as you would readily have admitted, if you had heard the criticisms—on the hanging committee. Some people wanted to know what artistic qualifications the majority of them had ever displayed to entitle them to judge works of art. I soothed one lady exhibitor by reminding her that men who are *cullah blind* and don't understand *drawing* can see beauties in a *picture* which others without those qualifications are apt to overlook. Her bright smile haunts me still. But I would ask the committee why they awarded the same value of prize for landscapes as for figure subjects. Do they really think that the merit of painting a landscape well is equal to that of painting a figure subject well? Because, if so, they have the opinion very much to

themselves. It certainly is not shared by the Royal Academy. Constable, whose breezy landscapes are more truthful, if less poetical, than Turner's, was, I think, the first, landscape painter admitted into the Royal Academy; and I believe the President of the time in congratulating him on his election, hurt his sensitive feelings by bringing the fact that he was only a landscape painter rather too prominently before him. But the committee's originality in this matter is as nothing in comparison with that which prompted them to award prizes for mere copies of pictures. I can only breathe a prayer that as they grow older they many grow wise. Rather a bold aspiration perhaps, for I have never seen an instance of its being realized.

I have an idea of my own as to how prizes should be awarded at these exhibitions. Let there be no committee of judges. After all theirs is a thankless task: they cannot please every one; and why should their ears be made to tingle when they have doubtless acted uprightly according to their lights or darkneses. The public themselves should be the judges. There should be a book kept at the door where the money is taken and every visitor on leaving should write into it the title of the picture or other work of art to which he awards his entrance money. This book should be open to inspection by exhibitors. At the close of the Exhibition the amounts awarded to each work of art should be made up, and after deducting a percentage for the expenses of the show, the balance handed over to the authors.

So the Government are going to take over the South Indian Railway as soon as ever they can. They are wise in this. That line has been in a chronic state of mixed pickles for some years. I see they are now advertising for Engineers. They have been in need of them for some time past, to judge from the lamentable failures on their works. A shower of rain cannot fall any where down south, but the next thing one hears of is a stoppage of the traffic in consequence of some bridge of theirs having retired into the Bay of Bengal. The men who have been carrying out the works of that railway lately, are either very much in advance of, or very much behind, the times. They certainly are not in step with their generation. I am afraid they do not read *INDIAN ENGINEERING*. I read an account some time ago of a bridge in America which those Yankees had moved bodily, I forget how many feet. They had not been able to do it without the assistance of a great deal of what is called in the profession *plant*. Nevertheless they seemed inclined to take great credit to themselves for the achievement. Now there had been a shower down South a few days before, and the usual notices had appeared in the local papers in due sequence. Thought I to myself here are these Yankees crowing over the fact that they have managed to move a bridge bodily several feet, although with the assistance of all that plant; but here are these South Indian Railway men, give them a little water, and they will move many bridges bodily several miles. And yet they never send any account of their achievements to the Institute of Civil Engineers, to which I believe some of them are subscribers. This is true modesty and deserves a wider recognition than my humble pen can give it. As a tip to the profession, I may say that the principle upon which they appear to go is to let nature act for them: and to give nature her due she does appear to do a good deal in her own way. They had an Engineer level with the times on their staff some years ago, and I would advise them to get him back again. His name was White.

With regard to the Travancore Railway, which I see a correspondent of yours is interested in, I believe it is not likely to be started for a year or two. It is not likely to be much of an opening for contractors when it is, as it will pass through very jungly unhealthy country; similar to that on which the Periyar Project Works are located. The staff on those works have had to leave them temporarily and are now employing themselves in laying out irrigation channels in connection with them in the Madura District.

I understand there are three or four Engineers at work on schemes for the supply of water to the Bangalore Cantonment. The work appears to present rather a difficult problem, for the place is not dominated by high ground in the vicinity which might be converted into a gathering ground: at least there is very little, and what there is, is so loose and porous that it scarcely throws off ten per cent. of the rain which falls on it.

[We do not agree with our Correspondent in his strictures on the S. I. R. Staff. The extent and number of bridge failures on the South Indian Railway are certainly not greater than those on the Madras Railway.—Ed., *I. E.*]

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, March 31, 1888.

Upper Burma.

With reference to *Burma Gazette* Notification, dated the 19th March 1888, the following officers are transferred from the Mandalay to the Kyaukse division:—

Mr. C. A. B. Target, Executive Engineer, 1st grade, to be in executive charge.

Mr. A. D. Anthony, Assistant Engineer, 2nd grade.

With reference to *Burma Gazette*, Public Works Department, Notification, dated the 16th March 1888, Mr. A. W. T. des A. de Crettes, Executive Engineer, 2nd grade, reported his arrival at Mandalay on the forenoon of this date and is posted to the charge of the Garrison Division, Mandalay, pending the arrival of Colonel E. N. Peters, R.E., Executive Engineer, 1st grade, or until further orders.

Lower Burma.

Mr. J. MacKenzie, Sub-Engineer, 2nd grade, and Honorary Assistant Engineer, has, with the consent of the Government of the Punjab, Public Works Department, been granted one month's privilege leave, with effect from the 12th March 1888.

Bombay, April 5, 1888.

His Excellency the Governor in Council is pleased to direct that the late Colonel A. R. Seton, R.E., should be considered to have held the temporary rank of Superintending Engineer, Class I., during the period he was Superintending Engineer, West of India Coast Defences, viz., from 23rd October to 12th November 1887.

Mr. T. D. Little should be considered to have reverted to temporary Superintending Engineer, Class II., during the same period.

Railway.

Mr. A. F. Johnston, Overseer, Public Works Department, attached to the Bellary-Kistna Railway, passed in the Punjab language in accordance with the tests laid down in Bengal Army Regulation.

Punjab, April 5, 1888.

Mr. W. Macdonald, Executive Engineer, 4th grade, sub. *pro tem.*, from the Patiala Railway Circle to the I. Circle.

Mr. H. C. Granville, Executive Engineer, 4th grade, sub. *pro tem.*, attached to the Kohat Provincial Division, is allowed furlough out of India for one year, with effect from the 1st April 1888.

His Honour the Lieutenant-Governor is pleased to sanction the following promotions in the Amalgamated Engineer Establishment of the General and Irrigation Branches of the Public Works Department, Punjab, with effect from the dates specified against each:—

Mr. A. E. Orr, from Assistant Engineer, 1st grade, sub. *pro tem.*, to Assistant Engineer, 1st grade, permanent rank, with effect from 9th October 1887. To fill an existing vacancy.

Mr. T. J. P. Jeffery, from Executive Engineer, 2nd grade, to Executive Engineer, 1st grade, permanent rank, with effect from 6th November 1887. To fill an existing vacancy.

Mr. B. Parkes, from Executive Engineer, 2nd grade, sub. *pro tem.*, to Executive Engineer, 2nd grade, permanent rank, with effect from 6th November 1887. To fill an existing vacancy.

Mr. H. L. Hebbert, from Executive Engineer, 3rd grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, permanent rank, with effect from 6th November 1887. To fill an existing vacancy.

Rai Ramdial Bahadur, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 4th grade, permanent rank, with effect from 6th November 1887. To fill an existing vacancy.

Mr. C. Roberts, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, permanent rank, with effect from 14th November 1887. To fill an existing vacancy.

Mr. E. H. Pargiter, from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 6th November 1887. *Vice* Mr. Parkes, promoted permanently.

Mr. G. S. Morley, from Executive Engineer, 4th grade, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 6th November 1887. *Vice* Mr. Hebbert promoted permanently.

Mr. F. W. Chanter, from Executive Engineer, 4th grade, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 6th November 1887. To fill an existing vacancy.

Mr. E. G. Fraser, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 6th November 1887. *Vice* Rai Ramdial, Bahadur, promoted permanently.

Mr. L. F. Robertson, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, sub. *pro tem.*, with effect from 20th November 1887. To fill an existing vacancy.

Mr. L. F. Robertson, from Assistant Engineer, 1st grade, sub. *pro tem.*, to Assistant Engineer, 1st grade, permanent rank, with effect from 26th November 1887. To fill an existing vacancy.

Irrigation Branch.

Mr. W. J. A. Bird, Executive Engineer, 4th grade, temporary rank, attached to Swat River Canal Division, is allowed furlough to Europe for nineteen months, from such date as he may avail himself of it.

Mr. S. Preston, Executive Engineer, 2nd grade, from the Joint Secretary's Office, which he left on the afternoon of the 31st December 1887, to the Jhelum Canal Survey Party, of which he took charge on the forenoon of the 1st January 1888.

Assam, April 7, 1888.

With reference to Notification, dated the 24th December 1884, the Chief Commissioner is pleased to appoint, from the 1st April 1888, Mr. E. L. Gramatzki, C.E., Executive Engineer, 1st grade, and Assistant Secretary to the Chief Commissioner of Assam in the Public Works Department, as Superintendent of Works, Southern Circle, Public Works Department, the duties of which appointment he will carry out in addition to those of Assistant Secretary until further orders.

N.-W. P. and Oudh, April 7, 1888.*Buildings and Roads Branch.*

Mr. A. W. Slater, Executive Engineer, 3rd grade, District Engineer, Aligarh, is posted to the Allahabad district as District Engineer.

Mr. J. Groves, Sub-Engineer, 3rd grade, Rohilkhand Provincial Division, is posted to the Aligarh district as District Engineer.

Mr. E. A. W. Phillips, Assistant Engineer, 1st grade, is transferred from the Budaun to the Bijoor district as District Engineer.

Rai Sohan Lal Sahib, Assistant Engineer, 1st grade, is transferred from the Bijoor to the Budaun district as District Engineer.

India, April 7, 1888.*Baluchistan.*

Mr. H. Phillips Assistant Engineer, 1st grade, passed the Departmental Standard Examination in Hindustani, on the 14th instant.

Central Provinces, April 7, 1888.

Mr. E. J. Ramsby, Executive Engineer, 3rd grade, Hoshangabad Division, is granted special leave with the usual subsidiary leave, for a period of two years, under the terms of Public Works Department letter of 3rd October 1887, with effect from 1st April, or from such date as he may avail himself of it. (To be substituted for former Notification.)

With reference to Notification, dated 14th February 1888, an extension of one day's leave is granted to Mr. G. G. White, Executive Engineer, 3rd grade, Kanhan Division.

With reference to Notification, dated 26th February 1888, Mr. G. G. White, Executive Engineer, returned from the privilege leave granted him, and resumed charge of the Kanhan Division from Mr. G. M. Harriott, Executive Engineer, on the forenoon of the 17th ultimo.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 2nd April 1888.

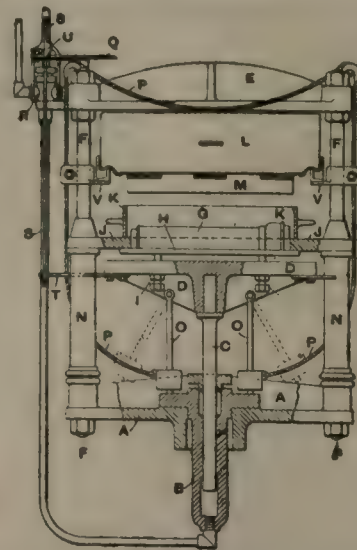
12 of '88.—Alfred Don, of No. 21, Cooper Street, Redfern, Sydney, in the Colony of New South Wales, Engineer.—For an improved apparatus for the prevention and consumption of smoke and more complete combustion of fuel in steam boiler and other furnaces.

21 of '88.—Percival Everitt, of London, England, Engineer.—For improvements in machines for testing muscular power.

23 of '88.—Eben Moody Boynton, Gentleman, of West Newbury, Massachusetts, United States of America.—For an improved railway system.

RECENT BRITISH PATENTS.

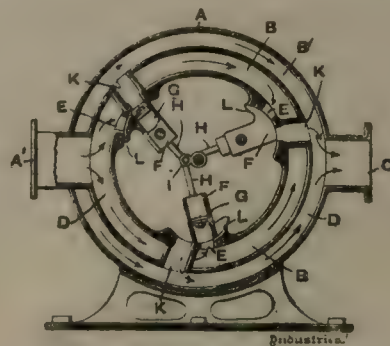
APPARATUS FOR MAKING MOULDS FOR CASTING.—T. Alley and J. A. McLehlan, Polmadie, Renfrew.—In carrying out this invention a hydraulic press is used, with its cylinder at the base, and with a platen mounted upon the upper end of the plunger. The annexed diagram illustrates the arrangement and mode of operation, when applied to mould a pipe length. The flask or mould box for one half of the pipe is moulded at each operation of the machine. The hydraulic cylinder B is fixed to the base plate A, and the ram C carries the table D. The pattern G is placed on a plate H, which can be accurately adjusted and levelled by the screws I. When in position to receive the sand, the plate H is raised by the ram up to the parting plate J through an opening in which



the pattern projects, so that one half of it is above the upper surface of the parting plate. The flask K is then placed on J, and the necessary quantity of sand is filled into it from the hopper L. The hopper is formed with a flat bottom, in two halves M hinged to its lower edges. After the sand has been run into the flask the ram is raised, carrying with it the platen, pattern, and parting plate up against the under side of the closed hopper bottom. The speed of lifting is such as to bring the sand, which projects up in a ridge along the middle of the flask, into contact with the hopper bottom, the sand is thus made to apply itself compactly in contact with all parts of the pattern. The ram is then lowered, and the parting plate is guided by the columns F, on which it slides until the legs N reach some stops on the base plate. The descent of the platen D carrying the pattern is for a moment arrested when the parting plate is stopped, but immediately afterwards it descends to a distance sufficient to lower the pattern through the hole in the parting plate. The flask with the moulded sand in it is then removed, and an empty flask may be substituted for the next operation. For the purpose of temporarily arresting the descent of the platen, two weighted legs O are jointed to its under side. These legs encounter the top flange of the hydraulic cylinder, but are, a moment later, drawn away by ropes P. The movements of the apparatus are controlled by a hand lever Q, connected to the valve box R, through which the supply of water passes. The speeds of the various parts are controlled automatically by a rod S which is adjustably fixed to a bracket T fixed to the platen. This rod is formed with a cam surface U at its upper end, which, when the hand lever Q is turned to, put the cylinder in communication with the exhaust, at first prevents the exhaust being fully opened, but allows it to be so when the ram has descended a certain distance. The inventors make four claims, for the sand supplier, for the arrangement of the platen and parting plate, and for the speed controller prescribed.—No. 3294. 4th March 1887.

RECENT AMERICAN PATENTS.

WATER MOTOR.—E. F. Ranks, Leviston, Minnesota.—This invention involves a new arrangement of pistons, cylinders, and valves. The whole apparatus is contained in the outer casing A, and the water supply enters at A¹ and leaves at C. The annular spaces B B¹ allow the water to pass to and from the cylinders G. The crank shaft goes through the centre of the casing, and the three piston rods H of the three cylinders G are pivoted directly to the crank pin I. The three cylinders G are placed at an angle of 120° with each other, and are pivoted to the outer casing as shewn. At the ends of the cylinders where they slide on the surface of the inner casing are guides L,



which serve to steady them in their oscillations, and to close the entrance ports E when the exhaust ports K are opened. Each cylinder in its movements comes in turn opposite the induction and eduction ports E and K which are provided in the inner casing, and thus the cylinders themselves act as their own slide valves. The course of the water is easily understood by reference to the accompanying diagram. The water enters through A¹ and passes into the annular space B. When the cylinders are in turn placed with their ends opposite the ports E, the water enters them and presses the pistons forwards. On exhaust the water passes back through K into the outer space B¹, from whence it escapes through the outlet C. The inventor makes three claims for this water motor.—No. 376610. 17th January 1888.

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Lahore, 24th March 1888. (110)

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27th March 1888. } Health Officer, M. C. (107)

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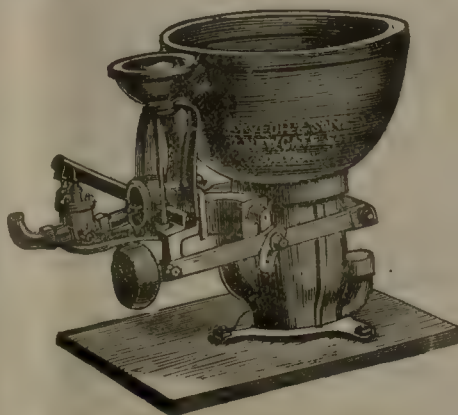
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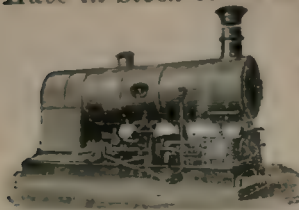
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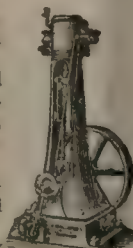
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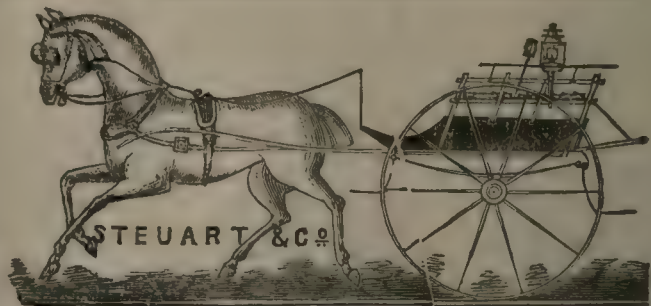
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Obituary.

WARD.—At Oak Park, Naini Tal, on the 12th April, Colonel David Ward, Royal Engineers.

INDIAN ENGINEERING.

SATURDAY, APRIL 21, 1888.

BRIDGE OVER THE INDUS AT SUKKUR.

MANY of our readers will have noticed an article on the staging for erection of the Sukkur Bridge in England in the *London Engineering* of the 9th March, and for the benefit of those who have not, we propose to say a few words on the subject,—this being a suitable time, as the Bridge is at last making some progress, and is an object of interest to the traveller by the N.-W. Railway.

It may not be generally known that with the exception of the Forth Bridge, which is again double the span, the Sukkur Bridge has much the largest span in the world, the longest at present being, we believe, the central arch of the Garabit viaduct in the south of France, which is 547ft.; we except suspension bridges, of course, of which there are several about 1,000ft.

The design of a bridge at Sukkur was obviously one of the first considerations in the construction of the I. V. S. R., and had indeed been considered in the earlier surveys of the S. P. D. R., whose Engineers proposed a bridge of the ordinary type on wells, just below the town of Sukkur.

The final location of the bridge ought to be the correct one, if the amount of labor spent in preparing projects has anything to do with it, as fresh surveys and projects were drawn up at intervals from 1872 to 1882, the first of which was for a suspension bridge with steel links, drawn up by General Browne, R.E., the type of which renders further consideration unnecessary, as all bridge Engineers will agree, that if a suspension bridge is to be built, it should be of wire cables.

The next project that appears to have taken any definite form was a three-hinged arch proposed by Mr. Molesworth, of which an examination by Major Allan Cunningham, R.E., was published in the Roorkee Professional Papers. This design was never worked out in detail, as it was concluded to adopt the present design, which was proposed by Sir A. M. Rendel.

The total weight of ironwork is about 3,250 tons, and the estimated cost Rs. 33,50,000, to which must be added Rs. 5,30,000 for the bridge over the Sukkur channel of the river (of which an account by Mr. F. E. Robertson will be found in the Roorkee Professional Papers) and Rs. 3,30,000 for plant, so that the total cost of bridging the Indus may be put down at about 40 lakhs.

The general features of a bridge of this size are, of course, an interesting subject for discussion, but no details have yet been published of this bridge, probably because such would occupy far more space than a periodical could well afford, and because this bridge, although large in itself, is quite eclipsed in England by the Forth. So far, we have only seen a few rather disparaging remarks in the *London Engineer* as to the general type, comparing the bridge to a combination of jib crane and roof truss; again commenting on the absurdity of erecting the cantilever whole, in a timber staging; and

contrasting this procedure unfavorably with that of the Forth. Now we are not concerned as apologists for the Sukkur Bridge, as will be seen below, but we must point out that these remarks are hardly fair. The bridge may be eccentric in outline and still fulfil the condition of economy. Without knowing the loads to be carried, the unit strains adopted, and the total cost, any criticism of the design is worthless. Even the weight is no criterion, as a bridge with less metal may cost more in erection and thus be the more expensive when completed.

As to the objections to the erection in England, this bridge cannot be compared with the Forth. The writer of the description of the staging to which we alluded above, expresses a very decided opinion that it was absolutely necessary to erect the whole cantilever, in order to ensure a perfect fit, and the comparison with the Forth Bridge has not much weight, the circumstances being so different. In the one case we have a bridge built at the place of erection, and in the other, a bridge that has to go abroad for erection, to a country where it would be impossible to remedy any misfit, so that it is probable the Consulting Engineer to the India Office exercised a wise discretion in having the bridge completely fitted in England. At the Forth Bridge also the junctions are all erected upon the ground before being sent out on the work.

The erection of such large bridges is a very important item in the cost and must be considered with as much care as the mere design for stability, for a bad joint or saving of a few tons of iron may prove a very false economy, by leading to greater cost in erection as well as delay, which means money, especially in the case of the Sukkur Bridge, where the traffic is worked by a ferry pending its completion.

Here, again, for want of detailed information, it is difficult to criticise the Sukkur Bridge fairly, but looking at the general outline we should say that it will not come out well on this point, as the great batter of the main members, and their varied type, would appear to render that great desideratum, a connected plan of erection, quite impossible; and we predict that the result will be to discredit the plan of giving lateral stability by battering the members. Two very good authorities on the subject, Claxton Fidler in his design for the bridge over the St. Lawrence, and Bender in his work "On Economy in Metallic Structures", have given their opinion decidedly in favor of placing the main members in a vertical plane, with suitable wind bracing.

The staging for erection of large pillars and guys in India, illustrated in our issue of 5th November 1887, appears to be a considerable item of expenditure that might have been avoided, by making the large pillar capable of standing on its own legs, and it has, in this country at least, the very great disadvantage of enormous risk of fire.

It is clear also that the central span is not designed so as to be capable of erection as a part of the cantilever, which would have appeared the most natural course to

pursue, so that the same installation which finished the cantilever, could have completed the central girder also. It appears to us that the arch originally proposed could have been both made and erected with much greater speed and economy than the present bridge, but the risk of lowering a member about 420ft. long, had probably something to do with the decision.

Of all the types that have yet been proposed for bridges of large span that must be built without staging, the five-hinged arch of Bender, illustrated in his work alluded to above, appears the best, both for economy of metal and erection together with safety.

Some ordinary sized bridges have been erected on this principle, for the sake of convenience in erection only, as under 500ft. span it possesses no superior economy to an ordinary arch or well designed parallel girder, but we hope to see the system tried on the next large bridge.

REVENUE REPORT OF BENGAL IRRIGATION FOR THE YEAR 1886-87.

THE Chief Engineer of Irrigation, Bengal, in his annual record of the work of the department, has generally a somewhat difficult task; and the report before us has even a less hopeful air than some of its predecessors. That the construction of the large canal systems of Bengal was a wise and necessary insurance against famine, no one acquainted with the history of the province in 1866 and 1873 will deny; but then it is equally certain that, in the irrigation of a rice country like Bengal, the direct receipts from sales of water will never be large enough to pay for the cost of working and maintenance, as well as the interest on the capital expended on constructing the canals. Madras has solved this problem by its classification of 'wet' and 'dry' lands, enhancing the revenue of the former, and placing the enhancement, fairly enough, to the credit of the canals. But from this expedient the permanent settlement has hitherto been strong enough to debar Bengal. As the Chief Engineer remarks, no assistance is obtained from indirect revenue or enhanced land revenue, as in other provinces.

The sums realised during the year from sales of water were under 10½ lakhs, being a falling-off of about two lakhs from those of the year previous. About half this deficit is however apparent rather than real, as the returns of 1885-86 were unduly swollen by the collection of a large amount of arrears. The assessments actually made during the year were about 9½ lakhs, or about one lakh less than those of the year before, this decrease being chiefly due to the favorable and well distributed rainfall.

On the subject of arrears, we are glad to see that Sir Steuart Bayley agrees with his predecessor in impressing on district officers the baneful effects of allowing any accumulation, and the necessity of realising all demands within the current year. The apathy displayed in this respect, during the earlier years of the present decade, by the civil officers of the chief irrigated districts in the province, in our opinion prominently exhibited the great evil of the dual administration of the canals. The cultivator was encouraged in the belief that he

had successfully wearied out Government into foregoing its just demands. Now that the day of reckoning has come, he finds himself compelled to pay, with the alternative of being sold up, not only the demand of the current year, but the half-forgotten arrears of many earlier years. In such a case what more natural than that he should raise the frenzied outcry, which necessitates the appointment of commissions of enquiry? In this connection the words of the Chief Engineer appear to us full of truth and meaning—"The stringent measures recently introduced to enforce payments of rates has placed matters on a considerably better footing; and any procedure, having for its object the prompt realization of demands certified as correct, will in the end make the cultivator appreciate both the benefits of irrigation and his own responsibilities." We trust that the Government of Bengal will continue to press this view on its district officers, and allow no relapse into the easy paths of former years.

The diminished receipts from irrigation are not compensated for by any increase in those from navigation, there being a decrease of over half a lakh in the tolls paid on boats. Regarding the Calcutta canals, it is noted that the receipts were affected by alterations in the tolls. There appears, however, to have been a general decline of trade, both on this route, and on those of the Midnapore and Orissa canals. We are glad, however, to observe that the traffic returns since published point to a revival of trade, and that the decline will only affect the year under review.

The occurrence of a large breach in the main weir of the Orissa system seems to have been the crowning misfortune of an unlucky year—resulting in diminished receipts both from water-rates and tolls, and involving heavy expenditure on repairs.

As already indicated, the general results are more unfavorable than usual, the receipts from all sources only slightly exceeding the working expenses; and the accounts shew that the total loss on "major irrigation works" in Bengal, inclusive of indirect and interest charges, have now mounted up to 50 per cent. of the capital expended.

PALMAM QUI MERUIT FERAT.

HOWEVER much opinion may be divided in regard to competition being the highest test of merit in an intellectual contest, there can hardly be the shadow of a doubt that in the appliances of modern science to the ordinary concerns of life, public trials alone regulate the standard of excellence. It is on this principle of fair field and no favor that we estimate the value of a discovery. The history of the world bears testimony to the fact that wherever an exclusive privilege has been granted to any community, or in the interest of any article of trade, it has been followed by disastrous consequences to the commerce of that country. A death-blow is thus given to healthy competition, and the result is that material progress is retarded. Where monopoly is permitted, a bane hangs over the prosperity of the land. There is no stimulus offered to the exercise of fair and

honorable rivalry, without which no State can rise to any degree of eminence. If such be the case in civilized lands, what must be its effects on India which is just emerging into daylight after having been shrouded in darkness for centuries past. Considering that we are on the threshold of important changes, and every year adds to the list of gigantic Engineering projects, such as have not been surpassed in any country on the globe, it behoves us to see how best we could adapt the scientific methods of the West to the condition, capacity, and pecuniary means of the Indian ryot. Having done this, the field should be left open to those who are prepared to employ their intellect and expend capital on the scheme. The little that has been done here in the way of improvement, is solely due to constant experiments and consequent modifications, but if a monopoly is set up, we have to halt on the road to advancement, and stagnation inevitably follows. Recognising this, we have at all times insisted on Government discouraging any other policy but that mentioned above.

The world is wide enough for all of us, and there is no just cause or impediment why anybody should appropriate any particular portion of it to himself. Self-interest, however, is at times too strong for us, and we yield to the temptation. Such have been our thoughts on rising from a perusal of three pamphlets in praise of as many sugar-mills which have been before the public for the last few years. Each of them is fortified with as many testimonials of its superiority over other mills as could be collected for the purpose. Now, it so happens that officers of a particular locality evince predilections for a certain mill, why or wherefore we could not say. The impression we entertain is that public competition should once for all decide the matter without reference either to a lawsuit or to the report of the Agricultural Department. But this seems clearly not to be the case, for each patentee blows his own trumpet, and is more anxious to discredit the invention of his rival, than to establish the virtues of his own. All these squabbles end in matters continuing in *statu quo* and the multitude are left to shift for themselves as best they can. All mundane affairs are shifting, and what satisfied the requirements of one decade are unsuited for the next and so on. But in India it is otherwise. Here merit is seldom recognised. The decision of the High Court *in re* the Beheea Sugar Mills, to which we referred the other day, is a case in point. It has done much towards bringing the question of monopoly before the public, and it would be well if the matter were thoroughly sifted. Without entering into a technical discussion of the rights of parties to their patents, we might, once for all, settle the question that the Beheea Sugar Mill has carried off the palm in competition with other contrivances of a similar character.

That the Beheea mill is the premier of its kind, the following particulars will shew. It has been tried all over India and found successful; it has held its own against native contrivances, and what is more to the purpose the machine extracts as high a percentage of juice

as is obtained in other countries with large steam-driven mills, which means an outlay of considerable capital, preventing at the same time the enormous waste of power, time, money and produce. This reduction in the daily cost of working, the quantity of work done being at the same time greatly increased, has led to the extension of the area under cane. In the district of Shahabad alone the increasing exports by rail since 1874, amount to about 30 lakhs maunds, giving at an average value of Rs. 3 per maund, Rs. 90,00,000. Where the Beheea mill competed with the native contrivance, it invariably showed a saving of from 12 annas to one rupee per maund, with increased value for improved quality. About 50,000 of the former have been disposed of to the cultivators during the last ten years, and on an average four-fifths of the number are annually at work. Taking this figure they yielded in 1884, 96,00,000 maunds of *goor* or *jagri*, which at the rate of Rs. 3 per maund will amount to Rs. 2,88,00,000. Next is the saving in labor per day, which is calculated to yield an annual saving of Rs. 117 per mill, or per family in each season. From a tabular statement compiled by Messrs. Thompson and Mylne, we find that from 1874-75 down to 1884 the total gain from 800 mills at work was Rs. 1,67,66,100. If any further evidence were required of their popularity, we may look to a publication of the Government of India, entitled "A List of Agricultural Implements and Machines which have been tested in India during the year 1886-87, and have been found efficient and useful." We then find that in some of the districts, from 300 to 500 of the mills were let out on hire to the ryots and the demand for them is on the increase. A sub-divisional officer writing from Khurda in the province of Orissa says:—"Originally the fee charged was one rupee for each mill for a month, and the fee has been gradually raised to Rs. 6." Now, as Orissa is the poorest of the three provinces in Bengal, we may rest assured that the ryots have, after all, found a good investment for their money or they would not have launched into an expenditure of what to them is a large amount.

THE PRODUCTION OF COAL.

United Kingdom.—The returns of the production of coal in the United Kingdom during 1887 have just been compiled at the Home Office, by the inspectors of mines, and advance copies have this week been sent out by the Board of Trade. It appears that the total production of coal in 1887 was 162,119,812 tons, as compared with 157,518,482 tons in 1886. There was thus an increased production in 1887 of over 4,500,000 tons. Large, however, as was the output of coal in 1887, it was under that of the year 1883, when 163,737,000 tons were produced. In Ireland there has been an increase of about 2,000 tons in 1887, the output having been 107,000 tons in that year, against 105,000 tons in 1886. The total number of persons employed about the coal mines of the United Kingdom in 1887 was 526,277, as compared with 519,970 in the previous year. Of the number employed in 1887, 428,540 were employed above ground, and 97,737 under ground. The increase in the quantity of coal produced in the United Kingdom during the last twenty years has been 59,584,000 tons, an increase equal to more than the total production of the whole of Continental Europe at the present time, excepting Germany.

India. Coal is the most important of the raw materials and unmanufactured articles imported into India. Including coke and patent fuel, in 1886 the imports amounted to 790,000 tons, valued at £1,308,400, an increase over 1885, the reason for which, in the face of the competition of the Indian collieries, is, that Bombay, now taking the lead in Indian commerce, is not in connection with the Indian coal fields, and had to rely on imported coal, of which it took 533,000 tons to supply its cotton mills, railways, and steam shipping. Bengal, with the Ranaganj coal mines at hand, needed 100,000 tons only of foreign coal. Burmese millers dispense with coal altogether, having found a substitute in the husks of rice, previously refuse. The output of the year 1886 was 1,294,221 tons, the number of persons employed in the various collieries was 22,745.

Notes and Comments.

GONE SICKLY AGAIN!—The market for Indian Gold Mining shares, in spite of the rigorous efforts of "nurses" and certain financial organs, has gone sickly again.

NAGPORE WATER-WORKS.—In the diagram at the bottom of page opposite 274 in our issue of 7th April the figures opposite 86-87 should be 492, 122 and not 427 221.

OFFICIAL INTELLIGENCE.—The escort of Major Yate's delimitation party met with a good reception at Kandahar on the 30th March, and reached Quetta all well on the 7th instant.

THE NIZAM'S P. W. D.—Mr. George Palmer, A.K.C. M.I.C.E., Secretary and Chief Engineer to the Nizam's Government, Public Works Department, proceeds shortly on four months' leave of absence. The acting appointment will go to Mr. Gauntlett, we suppose, who stands next in the list.

ITEMS FROM BURMA.—Our correspondent writes: A fire broke out at Kyauksi on the Toungoo-Mandalay Railway extension on the 8th instant, destroying Railway property to the value of Rs. 10,000.—An estimate has been prepared by the Engineer-in-Chief for doubling that portion of the Railway line between Rangoon and Insein. The cost is about 2½ lakhs.

THE TOUNGOO-MANDALAY LINE.—Through communication has now been established between Toungoo and Mandalay, the last rail connecting the two ends of the extension having been laid on the 13th instant. It is now possible for material trains to run through from Rangoon to Mandalay. Goods trains will probably run up to Mandalay by the middle of May.

OBITUARY.—We regret to announce the death of Colonel David Ward, R.E., Chief Engineer and Joint Secretary to Government in the Public Works Department of the North-West Provinces and Oudh. Colonel Ward entered the old Bengal Engineers in September 1854 and joined the Department in February 1859. He nearly attained his fifty-third year at the time of his death. His previous appointment was Chief Engineer, C. P.

E. I. R. ENGINEERING STAFF.—Mr. Peddie from Allahabad takes Mr. Denham's place at Calcutta—the latter going on leave. In consequence of these changes Mr. Beyts, Resident Engineer, Jamalpur, officiates as District Engineer at Muddapur, *vice* Mr. Wakley transferred to Allahabad. Mr. Highet goes to Jamalpur from Moghal Sarai as Resident Engineer. Mr. Abbott also goes on leave and Mr. Hoyle takes his place as District Engineer at Cawnpore.

INSTITUTE BRITISH ARCHITECTS.—At the Examination in Architecture held in London last month, two members of the Indian P. W. D. passed successfully and became qualified for the Associateship. These were Ibrahim Shaik Daud Ahmadi (of Bombay) and Oscar Oertel (of the N.-W. P.) This is the first instance of a native of India having attained this distinction. Both of these gentlemen were selected by the Government of India to proceed on a course of practical training in England.

IN RE "STORM WARNINGS."—The Meteorological Department which usually follows the course of cyclonic vortices with close attention and chronicles their break-up with marked satisfaction, seems to have ignored the tornado at Dacca altogether. The Simla reporter, who

is supposed to keep a watchful eye over all India, merely mentions in his telegram of the 8th instant that "rain had fallen in Dacca" on the previous day, the very day which had witnessed the devastation of the town.

P. W. D. CHIEF ENGINEER VACANCIES.—Speculation is again active regarding the coming changes occasioned by the departure on leave of Colonel Browne and the demise of Colonel Ward. It is understood that Colonel Luard will not return to India as soon as was expected; so that the disposal of two of the highest appointments in the Department—one in the N.-W. P. and Oudh and the other in Bengal—are at the disposal of Sir Charles Elliott, and it remains to be seen how he will dispense his patronage.

A NOVEL PROPOSITION.—Colonel Merewether proposed at a recent meeting of the Bombay Corporation that, as recommended by the Town Council, sanction be given to an expenditure of Rs. 1,000 for the offering of three prizes for the best designs of dwellings for the poor classes, and that these prizes be offered to native architects, engineers, and builders. Major Selby and several other members opposed the resolution, believing that the whole scheme would be purely inoperative. The resolution was lost.

CULTIVATION OF PADDY IN MADRAS.—Both wheat and paddy are staples in Southern India, but for each acre under wheat (grown only in the north of the Presidency) there are 250 acres under paddy. In 1885-86 between five and six million acres were cultivated with paddy, an acre yielding from ten to twelve-hundred pounds. Although grown more extensively than any other grain, it is not the chief food of the people: the majority eat the inferior grains grown on unirrigated land which forms 75 per cent. of the whole cultivated area.

THE TRAVANCORE RAILWAY.—The Agent of the South Indian Railway having inquired of the Madras Government, whether at least in the near future, State aid may be expected in the extension of the railway from Tinnevely into the Travancore State, he has been replied to in the negative. The Agent is therefore at present in communication with the Travancore State and his Board of Directors upon the subject, in view, if possible, of something being secured in furtherance of this projected line of railway into the Native State of Travancore.

THE BENGAL P. W. D. SECRETARYSHIP.—Colonel Browne, R.E., Secretary to the Bengal Government, in the Public Works Department, having received definite information relative to his prospects by the mail that arrived in Calcutta on the 12th instant, proceeded home in the steamer *Mirzapore* on Sunday last on leave, prior to retirement. The duties of his office, as we predicted, will, for the present, be carried on by Major Harrison, R.E., the Joint Secretary; but whether this arrangement will hold till Colonel Luard's return to India, we cannot as yet say.

EGYPTIAN LAKES RECLAMATION COMPANY, LIMITED.—This Company was registered last month in England with a capital of £300,000, in £5 shares, to acquire the benefit of a concession from the Egyptian Government, authorising the concessionaire to render cultivable the lands of Lake Aboakir. The number of directors is not to be less than three, nor more than ten; qualification, 100 shares; remuneration, £1500 per annum together with one-tenth of all surplus net profits in excess of the amount

required to pay 15 per cent dividend. Not a bad investment of £500!

THE CALCUTTA TRAMWAYS.—The report of the Directors of the Calcutta Tramways Company, Limited, for the year ending 31st December, shews a gross revenue of £56,943, and an expenditure of £45,450, the credit balance being £13,416. The Directors paid an interim dividend at the rate of 2½ per cent. per annum for the half-year ending 30th June, and now recommend a further dividend at the rate of 3½ per cent., making 6 per cent. for the year; that £2,000 be added to the reserve and maintenance fund (which will then stand at £6,247); and that £1,084 be carried forward.

BOMBAY WATER-SUPPLY.—The Bombay Municipal Corporation at a recent meeting considered and passed the resolution of the Town Council recommending that sanction be given to the grant of Rs. 10,000 from the one lakh of rupees sanctioned for new works during the ensuing year, to defray the cost of making a new catch-water channel to the east of dam No. 3, Vehar Lake, and in continuation of the existing channel to the west of the lake, and that the Municipal Commissioner be authorised to acquire such land as might be required for the work, if necessary, under the terms of the Land Acquisition Act.

THE ASSAM PUBLIC WORKS DEPARTMENT.—Referring to the Notification in the Public Works Department, dated the 24th December 1884, ordering the formation of two Circles of Superintendents for the Assam Public Works Department, to be styled the Northern and the Southern Circle, the Chief Commissioner is pleased to empower the Superintending Engineer of Assam to utilise the services of the Superintendent of Works, Southern Circle, for inspection duty when necessary in the Northern Circle also. The Superintendent of Works when deputed to such duty will exercise the same powers as when employed in his own Circle.

THE RUBY MINES.—Mr. Barrington Prown, the expert who was sent by the Secretary of State to explore the Ruby Mines, has returned to Mandalay. He considers the Ruby Mines at and around Mogok of exceptional and wonderful richness, and is inclined to think that the area at present worked represents but a small portion of the gem-bearing region, and that larger discoveries will yet be made. From a cursory examination, he is fully convinced that the mineral resources of Upper Burma are very great, and that in their development lies the immediate future of the country. Mr. Brown is arranging to thoroughly investigate the country between Wadeya and Mogok.

NAHAN FOUNDRY.—Lakhs of rupees have been expended in rendering the iron works at Nahan a most efficient foundry, with every appliance in the most expensive working machinery. Some years past, when the Sirhind Canals were being constructed, nearly the whole of the iron-work was supplied from the Nahan Foundry. The one great hinderance to success arises from the fact that for months together heavily constructed iron-work could not be conveyed from Nahan to the plains. Not only has the Nahan Foundry supplied very many public works with the very best description of cast-iron work, but rare specimens of high art have been turned out from it in brass and bronze work.

THE P. W. D. ENGINEERING STAFF.—One of our contemporaries says, that the Public Works Department

appears to be suffering from a complete congestion owing to the fall in exchange. There are rumors of reductions of establishment in all directions to follow an increasing suspension of promotion, which has now nearly really reached totality. The hardship falling on the Engineering Staff calls for special remedial measure. The Staff was inflated to a vast numerical strength to suit the State Railway policy which is now collapsing. It follows that some compensation is due to individuals, and it could take the form of special pensions which would admit of some of the Staff seeking other employment, while providing for promotion to such as remained.

THE EVILS OF CANAL IRRIGATION.—A paper on "The Evils of Canal Irrigation" was read by Dr. Thornton, C.S.I., at the Society of Arts on 21st March. The author fully admitted that the canals in India had conferred priceless benefits on the community. They had turned deserts into gardens; but they had been accompanied by three great evils. In the first place, they had extensively impoverished the soil, and, in the second place, they had led to the "water logging" and swamping of the soil, owing to the absence of proper subsoil drainage. The third evil was the spread of malarial fevers—the principal cause of disease and death in India—in the neighbourhood of the canals, especially the West Jumna Canal. We will discuss the paper in a future issue.

COMMERCIAL INACTIVITY.—A local paper declares that trade is abnormally dull in Calcutta at present, and the fact is patent to all in the appearance of the Hooghly. The "forest of masts" which we are accustomed to see stretching from the Esplanade to Garden Reach has disappeared, and only a mere fringe of shipping remains. It is, indeed, many years since dulness was so prevalent in our foreign trade *viâ* the Cape. Export to Europe is going on chiefly *viâ* the Suez Canal, and the supply of steamship tonnage being quite adequate to the demand, there is no immediate prospect of a rise in steamer freights diverting shipments to the alternative route. Until this be brought about by an increase in the volume of exports, we are unlikely to see the river resume its normal appearance.

THE EXTENSION OF THE TRANS-CASPIAN RAILWAY.—Reuter informs us that the railway has been pushed on—by way of Bokhara—to Samarkand, a fresh extension of 230 miles, which has been completed at almost as speedy a rate as the famous Ruk-Sibi "mile a day" line. Before the end of the year General Annenkoff, the Russian Engineer-in-Chief, will probably be able to notify an extension from Samarkand to Tashkend, the seat of Russian Government in Turkestan. When the Samarkand-Tashkend extension is finished, the Trans-Caspian main Railway will be complete. The Russian harbour Mikhailovsk on the Caspian will then be in direct communication by rail and telegraph, with the seat of the Turkestan Russian Governor. The railway from the Caspian into Central Asia complete up to date is 891 miles long.

ANOTHER HYDERABAD (DECCAN) SCANDAL.—The irregularities by which the valuable mining rights in the Nizam's Dominions have been alienated for an almost nominal consideration have been exposed. The first stage in what promises to prove a series of revelations of extraordinary interest has been reached by the suspension of the notorious Abdul Huq, Public Works Minister and Home Secretary, who negotiated the sale of these rights to the London promoters of the Hydera-

bad Company. The matter is at this moment engaging the active attention of the Government of India and the Secretary of State, as well as that of the Government of the Nizam. In the meanwhile the office of Home Secretary is to be abolished, and the Railway is to be handed over to the Public Works Department. Mining will form a separate department by itself.

TWELVE-TON HYDRAULIC WHARF CRANE, KARACHI HARBOUR.—This crane lifts a load of 12 tons, at a radius of 34ft., through a vertical height of 60ft. and swings through 480 deg.—1½rd circle. The lifting-rams are arranged to lift up to six tons with the smaller, and up to twelve tons with both engaged. They have a stroke of 10ft., a doubled lin. chain being wound in multiple of six to give a lift of 60ft. The crane has a wheel base of 15ft. in the direction of the rails, and 12ft. 10in. from centre to centre of rails. This gives stability at any horizontal angle of jib, but an additional security is obtained by hooking the pedestal to the wharf girders. The jib and mast are of steel, and the pedestal frame of wrought-iron plates and angles. The engines indicate 160 horse-power, and the accumulator ram is 17in. diameter by 17ft. stroke.

"RATHER PECULIAR."—The Karachi Correspondent of the *C. and M. G.* writes: There is a very interesting article in *INDIAN ENGINEERING* on the "Karachi Harbour Works," accompanied by a map of works in progress and proposed. These works, when completed, will make our harbour second to none. Of the "5 Ship Wharf" three berths are now completed, and the other works, such as the removal of "Deep Water Point," the new alignment of Railway to run alongside the "5 Ship Wharf," etc., are in active progress. One feature of this report strikes us as *rather peculiar*, viz., that the Government of India in granting the loan to complete the Ship Wharf, stipulated that all the material should be procured through the *India Office*. This seems to us a *rather peculiar* condition, for we cannot see why the Trustees should not have the power to buy in the open market, where they could probably secure the same article at a cheaper rate.

THE INDIAN TELEGRAPH DEPARTMENT.—We learn from the latest home news that the India Office Despatch to the Government of India, dated 25th August 1887, on the subject of the reorganisation of the Telegraph Department, has just been issued as a Parliamentary Paper, Mr. King having moved for its production. It proves conclusively, as Sir John Gorst intimated, that some of the most objectionable provisions of the reorganisation scheme, which was promulgated at Simla in October last, are really the work of the Government of India. This being the case, it was scarcely fair to issue the scheme as the final decision of the Secretary of State. The scheme is not that which the Secretary of State sanctioned, and it has proved utterly inadequate to remove an admitted hardship. Lord Cross cannot let the matter remain where it is, but must reconsider the question of retirement in the light of the experience gained by the blunder committed at Simla.

HOW TO FIND AN ARCHITECT.—Referring to the proposal to appoint a triumvirate of Engineers to save the Bombay Corporation the trouble of further thought and responsibility in connection with the proposed Municipal buildings, a contemporary says: Why Engineers should be supposed to have a monopoly of the architectural instinct we are not informed. If the Corporation were puzzled as to the

best way to reclaim Back Bay, or make an underground railway, or tunnel Malabar Hill, it would seem strange if three architects were selected to solve all doubts and shew the way to business. The public would in such a case prefer to see the matter in the hands of Engineers and not of builders. If any one desires to measure the distance between the principles of engineering and the principles of architecture as applied to public buildings, he has only to stand on the Esplanade and compare the Convocation Hall with the High Court; he will then realise the immensity of the interval between the conceptions of a Gilbert Scott and those of a Royal Engineer in matters architectural.

COMMERCIAL UNION ASSURANCE COMPANY, LD.—The Annual Report says that in the Fire Department the net premiums of 1887 amounted to £ 769,265, being an increase of £ 12,973, as compared with the year 1886, and the losses to £443,588, being 57½ per cent. of the premium income as against 65½ per cent. in the previous year. £35,000 has been carried to Profit and Loss, and the Fire Fund stands at £647,586 as against £581,059 last year. The Life Department issued 556 Policies, assuring £442,241, and the New Premiums amounted to £16,467. The Claims amounted to £79,229, and the Life Fund increased by £65,648. In the Marine Department the net Premiums were £175,118, the net Losses were £138,366. £20,000 has been carried to Profit and Loss, and the Marine Fund stands at £252,414. The Profit and Loss account closed with a balance of £41,683, and the Directors recommend the payment of a dividend at 15 per cent. A bonus to Life Policy holders on the participating scale, in respect of the quinquennium ended the 31st of December 1887, has been declared in London.

COAL MINING IN JAPAN.—The German consular reports contain some interesting information concerning the prospects of coal mining in Japan. Rich coal-fields are found in the islands of Kiusiu and Yesso. In the former there are four basins now being worked upon, having a superficial area of 400, 155, 90, and 40 square kilometers respectively. The Karatin coal is a seam some 5 feet thick, in a sandstone formation, and having an extent of about 100 square kilometers. In the islands of Amakusa, to the west of Kiusiu, there is anthracite. An extensive coal-field exists also in the neighbourhood of Tokio. There are besides, in other localities, brown coal and lignite in abundance. The Japanese have begun to work some of these seams. The output amounted to 700,000 tons in 1881, but every year has seen a great increase. The German Consul remarks that the Japanese use the best European machinery and follow the most approved methods of mining adopted on the Continent. It might be worth while to bring machinery of British manufacture to the notice of the Japanese, who have lately bought largely in Germany.

AKRA (GOVERNMENT) BRICK FACTORY.—The moulding of bricks at Akra, near Calcutta, for the season has closed. Upwards of 825 lakhs of bricks have already been moulded and nearly 760 lakhs already kilned or clamped. The weather remaining fair in another 10 days, the whole of the fields will be cleared of all green bricks and the result will be a great success. The result of burning is very satisfactory, nearly 80 per cent. first-class are being turned out. So it is fully anticipated that the 1,200 lakhs of bricks that Government had undertaken to supply the Kidderpore Docks with, will be nearly completed in this year's manufacture,

for as much as 600 lakhs of bricks have already been supplied to them by the Factory. The Port Commissioners, trains are carrying away daily an average of 2½ lakhs, or nearly 60 to 65 lakhs per month; or, in other words, will complete the removal of the whole stock by the time the next season's outturn begins to be received. The Factory is keeping very good health, though the influx of labor, we hear, is something extraordinary. Over 10,000 people have gathered there. The sanitary arrangements are very well kept; the whole of the coolies are supplied with water from local filters for drinking and culinary purposes.

SIND—SLIGHTED AND NEGLECTED.—A proposal was some time ago put before the Bombay Government for the construction of a surface line of railway from Hyderabad to Umerkot, a distance of 100 miles about. This line was surveyed, and it was shewn that the earthwork, including bridges over canals, could be constructed for something like five lakhs of rupees. The North-Western Railway Company was willing, and is willing, to put down used rails, and stock the line with second-hand rolling-stock; in fact, make a feeder line of it. The Hyderabad Local Funds offered to contribute 1½ lakhs towards the cost of construction, without asking for any interest or return. They pointed out that within the range of this railway there are 80,000 acres of the best wheat growing land in the province, commanded by canals, now lying uncultivated, because of the expense of transport; and a recent Commissioner in Sind, put it on record that, in his opinion, the increased revenue which this railway would create would much more than cover the interest on cost of construction, leaving profit on traffic out of the question entirely. The balance required to give Sind this 100 miles of railway was ¾ lakhs about, the assistance of the Bombay Government was asked in the matter, but nothing has been heard of the project for some months, and it can only be presumed that it reposes calmly in some official pigeon-hole.

THE STRAITS SETTLEMENTS.—Our correspondent writes:—I don't know if you are troubled with a verandah question in India, but here in Singapore we always have been. When plans are passed by the Municipal Commissioners the houses must always have a verandah facing the street with a clear width of 5 feet for footways. So far so good, but when the houses are built the verandahs are so obstructed with goods and merchandise that it is impossible for people to pass. The new ordinance (Act IX. of 1887) had a clause dealing with this matter, and there was a great difference of opinion on the Board, as to how the clause should be carried out. The clause had been ordered to be carried into effect by the old Board after one month's notice, but the new Board went in for obstruction, and some of the members did a little playing to the gallery. The result of this division on the Board was the Verandah Riots of 1888, when a rowdy mob of Chinese held the town practically for three days. All work was absolutely stopped, and many Europeans were assaulted by large gangs of Chinese. We officials all had to go about armed, and even then some of us were freely stoned until we drew our revolvers on the mob. Several Municipal servants were injured in the midst of the disturbance. The Commissioners issued a proclamation stating that they only wished for 3 feet clear passage. The riot however continued for another day, and now it has subsided; but the verandahs in town, except about the European godowns, are worse than ever. Comment is unnecessary.

Current News.

SIR CHARLES ELLIOTT reached Simla last Wednesday.

THE Surveyor-General of India, Colonel Thuillier, and his establishment, have arrived in Simla for the season.

DR. BURGESS, the Director-General of the Archaeological Survey of India, has left for England, where he will, as usual, spend the next six months on duty.

THE military surveyors having completed their work with the Intelligence Branch in Burma, have been directed to return to India by the first opportunity.

MR. W. F. WIESE, Superintendent of Telegraphs in Rajputana, died of cholera on Monday. He has been upwards of 22 years in the Telegraph Department.

COLONEL F. G. OLDRAM, Examiner of Accounts, Military Works, has obtained six months' leave to England, and will be succeeded by Mr. J. B. Braddon from Calcutta.

MEASURES for the afforestation of the hills around the military cantonment of Dugshai and other military hill stations in the Simla district are now being considered.

THE following officers of the Royal Engineers are brought on the strength of the Indian establishment:—Lieutenant B. A. James, C. H. Heycock, and F. F. Weedon.

COLONEL A. J. FILGATE, Accountant-General and Deputy Secretary Accounts Branch, Public Works Department, India, left Delhi on the 14th instant, for Umballa, en route to Simla.

THE Native States of Travancore, Cochin and Pudukotta, in the Madras Presidency, are to be topographically surveyed by the Imperial Survey Department during the current year.

AN accident resulting in the death of six persons is reported in Calcutta. A house in Kyd Street was being repaired, when the whole building collapsed owing to the removal of some archways.

THE Meteorological Department has just published a volume of charts of the Arabian Sea, and the adjacent portion of the North Indian Ocean, shewing the mean pressure, winds and currents in each month of the year.

COLONEL D. H. TRAIL, R.E., Examiner of Accounts, Public Works Department, goes home on six months' special leave, as preliminary to his retirement from the service. As to his successor nothing is yet known.

THE average time occupied in the transmission of messages from Calcutta to the United Kingdom by the Indo-European Telegraph Company during the ten days ended the 15th of April, was one hour and fourteen minutes.

ARRANGEMENTS have been made for the immediate survey of the Ahiri Forest Reserves in the Central Provinces being undertaken by the Forest Survey Branch simultaneously with the survey of the forests in the Raipur district.

THE Government of Bombay have sanctioned the scheme of a railway from Miraj on the Southern Maratha Railway line to Kolhapur, a distance of about thirty-six miles. The expenditure is to be met from the Kolhapur State Treasury.

CAPTAIN J. CLIBBORN, Executive Engineer, Canals, Muttra, is at present in Allahabad arranging the papers belonging to the Sardah Canal, which survived the late Secretariat fire. Captain Clibborn will, we learn, be shortly transferred to Bareilly.

THE authorities at the Forest School at Dehra have been instructed to carry out, during the current year, experiments in extracting resin and turpentine from the *Pinus Longifolia* and *Pinus Excelsa* trees, which grow abundantly in the forests of the School Circle.

CONSEQUENT on Colonel E. Swetenham proceeding on leave, Major Pulford, R.E., will officiate as Superintending Engineer, Allahabad, at the same time retaining his work in the Railway Branch. Mr. Henslowe will probably act for Major Pulford, in the regular Public Works Branch.

THE Japanese Government is importing into Japan large quantities of teakwood from Burma and Siam for the Yokosuka and other arsenals and dock-yards. It has been found that the timber used until lately for building Japanese men-of-war, the *Kiaki*, is for many reasons unsuitable.

THE Russian military authorities having sent emissaries to inspect the fortifications of Herat, lately erected under the guidance of English officers, have received a report that the ramparts and earthworks do not possess any great defensive value, and their importance had been much exaggerated.

LAST week an extensive fire occurred at Mulkapur on the G. I. P. Railway, in Khandesh, in which about fifty houses were burnt down. The loss is estimated at about Rs. 10,000. A fire occurred at Trimbuck, in the Nassick District, in which the Koli habitations of the place were all burnt down.

ALL expenditure on Engineering work in Upper Burma will be carried on by the Public Works Department from the 1st April 1888. All expenditure on such work by the officers attached to the Field Force ceased on that date, but this order will not apply to the work being carried out at certain points—Koni, Pwehla and Fort Stedman, to wit—on the Southern Shan Hills.

THE Chadarghaut Water Scheme will be considerably delayed. Mr. Palmer, the Chief Engineer and Secretary to Government, was working at it himself, and we hear that it will remain as he left it till his return from England. Mr. A. C. Davis, who was assisting Mr. Palmer in this project, will temporarily have a general supervision over the work of the Engineering staff of the Chadarghaut Municipality.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

A SUGGESTION.

SIR,—I notice with satisfaction, in the *Gazette of India* of 24th March, the promotion of Mr. Richard Dalley, Mechanical Draftsman on the N. W. S. Railway, after 2 years' service in the Subordinate Grade to Class IV. of the Superior Revenue Establishment, Loco. Department, and we would like to see more appointments of this description in preference to that of young tyros, who, on paying a premium, are pushed through a Loco. Workshop, and, if heaven-born, succeed in getting appointed to State Railways as Assistant Loco. Superintendents to boss older, more practical and better trained men, who have to teach their young masters their duties.

I have reason to believe that there are now several subordinates in G and H classes of the State Railways who are not only first-class Mechanical Engineers, but have education and administrative ability fitting them for the higher ranks of the service, and on their behalf I would suggest that an annual report be called for, on the conduct and qualifications of these men, and if worthy, they be considered eligible for vacancies in preference to importing young striplings from home. A case has been known where a really good competent man was overlooked by a Loco. Superintendent in order that the son of a friend or a distant relative may first be provided for.

EXPERIENCE.

SOME ANOMALIES.

SIR,—An examination of the classified list shews at once that Railway Engineers are at least 5 years behind officers of other departments of the Railway Branch.

1. In January 1890 a Traffic Officer, already in Class II., will, at the age of 36, be drawing Rs. 950 per mensem, the pay of an Executive Engineer, 1st grade. Again the youngest Examiner, IV. Class, drawing Rs. 950 per mensem, is only 35 years old.

Now the youngest Executive Engineer, 1st grade, permanent, is 41, and the youngest Executive Engineer, 1st grade, sub. *pro tem.*, is 40.

2. The youngest Examiner, III. Class, drawing Rs. 1,100 per mensem, is 41 years old only.

If he were an Engineer, he could not possibly be drawing more than Rs. 950 per mensem, would only be an Executive Engineer, 1st grade, and would be almost the youngest man in that grade.

3. The Traffic Superintendent of one of the most important State Railways has only done 11½ years' service. If he were an Engineer, he would not have charge of a division.

Now it is not a mere matter of pay. The result of all this is that senior Engineers must frequently find themselves working under officers of other departments who are necessarily inferior to them in every particular but luck. The extraordinary part of it is that such anomalies not only occur without protest, but scarcely occasion surprise.

DOG-SPIKE.

AN INVENTION.

SIR,—Seven years ago (15th December 1880) I obtained a patent from the Government of India for levitating apparatus, and could not find any one to pronounce an opinion on it, till the other day an electrician pronounced the electrical part of

the invention all right, but could not understand how a carriage could levitate itself, and likened it to a man catching hold of his hair and trying to lift himself. He surely could never have stood on a platform weighing machine and weighed himself with one finger.

The drawings are in the Patent office at Calcutta—showing all details. The late Sir Salar Jung assisted me in the cost of certain experiments I made, and in patenting the invention, but I was averse to accepting funds for making a trial on a large scale, as I considered it best to patent the *principle* and await the development of the electric engine—as I believe that in future the description of the invention will run thus:—A small percentage of the electricity used to propel the engine passes through miles of wire (copper) in the electro-magnets, levitating the carriages 90 per cent., and returns to the engine somewhat diminished. The split tube arrangement of the flanges of the central rail with coils of wire in them eliminates magnetic induction or magnetic friction, the induced magnetism slipping away into the earth, etc., etc.

If you or your readers are satisfied that the invention is not a "myth," as some have styled it, and can elicit opinions about it in your valuable Journal—showing its great commercial value—I think the Nizam's Railway would be the first to try it on train lines at the Singareni Coal-fields.

HENRY W. ALLEN,
District Engineer.

CAMP BHEER, Nizam's Dominions; April 2, 1888.

CALCUTTA GAS WORKS MANAGER'S ADVERTISEMENT—COKE ADULTERATION.

SIR,—I was very much amused on reading the above advertisement.

Mr. Editor, I think it is a great pity when the Ghee Adulteration Bill was passed that a clause was not put in for Coke ditto; then there would have been no occasion for Mr. D. C. Niven to warn the public.

First, there is no such a thing as coke adulteration. The advertisement looks like a practical hoax. For his information, allow me to state that there are two classes of coke made up here—*soft coke* and *hard coke*. About 30 to 40 waggons of "soft coke" or *charcoal* is sent away daily for the Calcutta market, as fuel entirely for cooking and house firing. This class of coke is commonly called "*Porta Coila*."

The latter is made of fresh cut steam coal. It is put in heaps as it comes out of the mine, then set on fire and burnt until all the smoke is exhausted; then water is put on at once, and the product is ready for despatch. Another way that "soft coke" is made is by putting the coal in a large heap, with a flue up the centre; this is set on fire and worked exactly like wood charcoal is done in the forests of Europe. Both ways make a very fine light "soft coke," which makes a splendid bright hot, slow burning, cheap fire. Nothing to equal it.

The former kind or "hard coke," is like gas coke, and will not do for cooking or house fuel. It is too hard and dense, requires a blast engine to burn it. The *hard coke* is made from the fine slack which comes straight out of the pits; much trouble has to be taken to get this slack *fresh and clean*. "Hard coke" is never *palmed off for cooking coke*, but is all bought up for *blast furnaces and foundries*, and fetches a ready market at Rs. 8 to 10 per ton, while "soft coke" is less than Rs. 5.

Allow me to point out to Mr. Niven that dross, old heaps and refuse will not make any kind of coke. This any practical man of experience knows. Also allow me to point out that the only place where dross sweeping and refuse can be made use of is at *gas works*, where they have *closed ovens or retorts*, and the same are heated up to *very high temperature*. We are very sorry we have none of these resources up here that we could do the same.

Fish dealers as a rule don't invite public's attention by calling out bad fish.

DUSTHEAP, BLACK COUNTRY; } "DISINGENUOUS SERVANT,"
April 10, 1888. } Manager.

P.S.—Some collieries are now being worked entirely for soft coke making, which can be put into Calcutta market at 3 or 4 annas per maund, inclusive of freight &c.

The meteorological phenomena accompanying the building of railroads in Mexico are receiving the attention of scientific men in that country. Recent serious damage done by washouts on the northern section of the Mexican central road was due to waterspouts bursting on the track, and it is a curious fact that waterspouts seem to be attracted by the iron track and telegraph wires. Engineers on the line of the Guadalajara branch of the Mexico Central Railway have noted that as fast as the construction advances rain follows, and they hold that this is due to the large lot of steel rails on flat cars which are carried forward as fast as the work of construction permits. The most noticeable fact is that the country is dry in advance of the construction trains, and also behind them for many miles. Rains beat down, as described, in bucketsful, just where the steel rails are, but only in circles a few miles in diameter.

New Books and Reprints.

ART AND ARCHITECTURE.

- ATTWELL (Henry) The Italian Masters, with Special Reference to the Italian Pictures in the National Gallery Post 8vo, pp. 188. Low... 3/6
BLAGROVE (George H.) Marble Decoration, and the Terminology of British and Foreign Marbles. A Handbook for Students. With 28 Illusts. Post 8vo, pp. 116. Crosby Lockwood ... 3/6
BRUNNER (A. M.) and Tryon (T.) Interior Decorations. Illust. 4to New York ... 15/
ENGLISH Artists of the Day: A Technical Directory, including the Royal Academicians, Associates of the Royal Academy, Members of the Royal Society of Painters in Water Colours, Members of the Royal Institute of Painters in Water Colours, Members of the Royal Society of British Artists, Exhibitors at the Royal Academy, and others, Edit. by William Hoe 8vo, pp. 53. Kent and Co ... 2/6
GARDNER (F. B.) The Painter's Encyclopædia. 12mo, pp. 433. New York ... 10/
GABIN (P. A.) Outlines of Industrial Drawing: An Elementary Manual for the Self-Instruction of Teachers and Pupils of Public and Private Schools. Part 1, First Four Years, or Primary Work, Free-hand. Illust. 8vo, bds, pp. 118. Oakland (Cal) ... 4/
McLAUGHLIN (M. Louise) Painting in Oil: A Manual for the Use of Students. 12mo, pp. 111. Cincinnati ... 5/

Announcements.

By Messrs. Crosby Lockwood and Son:—

The Decorator's Assistant: A Modern Guide for Decorative Artists and Amateurs, Painters, Writers, Gilders, &c. Containing upwards of 600 Receipts. 3rd ed.

By Messrs. Sampson Low, Marston & Co.

Shakspeare's Heroines: A Series of Studies by the Greatest Living British Painters. Goupilgravure Illustrations.

ASTRONOMY AND METEOROLOGY.

- CLEVERLEY (G W) The Law of the Universe: An Undelivered Lecture, 8vo, sd, pp. 44, Brown (Hull), Simpkin ... 1/
DISCURSIVE Essays on the Phenomena of the Heavens and Physical Theory of the Earth. In 2 parts. Part 1, containing a New Theory in Astronomy Based on the Translatory Motion of the Sun, and a New Theory on the Element of Gold in the Universe, followed by a Description of the Probable Origin of the Earth, Formation of its Ocean Crust, Continents and Islands, including a Concise Review of the Evolution of the Organic Beings on its Surface by Cosmopolites. 8vo, pp. 338. London Literary Society ... 6/
My Telescope, and some Objects which it Shows Me: A Simple Introduction to the Glories of the Heavens. By A Quekett Club Man. 12mo, pp. 84 Roper and Drowley ... 2/6

Announcement.

By Messrs. Ward, Lock & Co.:—

Marvels of Astronomy, including an account of the Solar System.

CHEMISTRY AND PHYSICS.

- Cross (G N.) Elementary Chemical Technics: A Manual of Directions for the Fitting-up, Care and Use of School Laboratories. 12mo. Boston ... 6/8
HUNT (T. S.) A New Basis of Chemistry: A Chemical Philosophy. 12mo. Boston ... 10/
JAGO (W.) Inorganic Chemistry: Theoretical and Practical. 9th ed., Re-written and greatly Enlarged. 12mo, pp. 330. Longmans... 2/6
THORNTON (John) Elementary Physiography: An Introduction to the Study of Nature. With 10 Maps and 158 Illusts. (Longmans Elementary Science Manuals.) Post 8vo, pp. 250. Longmans ... 2/6

Announcements.

By Messrs. Macmillan & Co.:—

Examples in Physics. By D. E. Jones.

Popular Lectures and Addresses on Various Subjects in Physical Science. By Sir William Thomson.

Radiant Light and Heat. By Balfour Stewart.

ELECTRICITY AND MAGNETISM.

- MUNRO (John) and Jamieson (Andrew) A Pocket Book of Electrical Rules and Tables for Use of Electricians and Engineers. 5th ed., revised. Oblong. Griffin ... 7/6

Announcements.

By Messrs. Thomas De la Rue & Co.:—

A Treatise on Electricity and Magnetism (Methods of Measurement and Applications). By E. Mascart and J. Joubert. Translated by E. Atkinson Vol. 2.

By Messrs Ward, Lock and Co.:—

Marvels of Electricity and Magnetism.

ENGINEERING AND MECHANICS.

- BROUGH (Bennett H.) A Treatise on Mine Surveying, With numerous diagrams 8vo, pp 314. Griffin ... 7/6
HUDSON (J. R.) Tables for Calculating the Cubic Contents of Excavations and Embankments. Vol. 2 8vo, pp. 84 New York ... 4/6
REYNOLDS (Michael) Locomotive Engine Driving: A Practical Manual for Engineers in Charge of Locomotive Engines, 8th ed. Comprising besides other additional matter, a Key to the Locomotive Engine. Post 8vo, pp. 270. Crosby Lockwood ... 4/6
SAUNIER (C.) The Watchmaker's Handbook. Trans from the French and considerably enlarged by Julien Trippin. By Edward Rigg. With numerous Woodcuts and 14 Copper-plates. 2nd ed., revised with Appendix. Post 8vo, pp. 510 Crosby Lockwood ... 9/
SPONS' Engineer's Price Book; Giving Tables for Estimating Cost of Materials and Labour on Current Prices, and many Useful Formulae for the use of Engineers and Ship Builders: Together with a List of Members of the various Engineering Societies throughout the United Kingdom. 8vo, pp 436. Spous ... 7/6
SPONS' Architects and Builders' Price Book With useful Memoranda and Tables. 15th ed. Post 8vo, pp, 310 spous ... 3/3

General Articles.

THE GREAT INDIAN PENINSULA RAILWAY VICTORIA TERMINAL BUILDINGS, BOMBAY.

II

THE different plans, which we illustrate, give the position and arrangement of the offices with their respective dimensions. They are spacious, light, well ventilated and convenient. The corridors around and those across the building are wide and spacious, and give access to all parts of the building. It will be observed that each head of Department has an office, private-room, bath-room, lavatory and W. C. such a suite of rooms being a great boon to railway men who have to travel frequently on inspection and other duties, as meals can be served up from the Refreshment-rooms while bathing and other matters of toilet are being proceeded with, which means much saving of time. The station is on the north side of the Administrative Offices and is approached from the west-side through the large Waiting Hall and by a large entrance immediately in the centre of the flat roof that covers the large platform and which connects the main building with the large sheds. The flat roof 250ft. \times 75ft. with its ornamental brackets, columns, caps, &c., is a fine specimen of wrought-iron-work design, and we may note that the Company's arms and monogram which have been freely introduced are most effective. The decorations are rich in colour and in strict keeping with the other portions of the building. The large iron sheds (each 116ft. span) over platforms and sidings have been decorated in colours touched with gold, and although simple, have a light and pleasing effect, which was somewhat difficult to obtain owing to the large surfaces to be dealt with. The Terminus is provided with two large clocks, one with a dial 8ft. 6in. in diameter in the central gable of the building below the dome, and the other with two dials each 10ft. 6in. diameter and 116ft. apart worked by one set of works in the gables of the large roof of station overlooking the platforms. The mechanism of the latter clock is ingenious and unusual. All the large clocks were supplied and fixed by Messrs. Lund and Blockley. The foliated and ornamental sculptures of the building were carved by native carvers from models supplied and designed by Mr. Gomez and the students of the Bombay School of Art under the direction of Mr. J. Griffiths, the Principal, and are quite equal to anything of the kind produced in Europe.

The statuary was executed by Messrs. Earp and Son, of London, in a most skilful and artistic manner, which we will now describe. The figure of Progress before mentioned, is colossal and surmounts the large dome and is represented by a draped female resting her left hand upon a winged wheel by her side, while in her right hand she carries a flaming torch of copper gilt, which has a fine effect when the sun shines upon it. The hand of the figure is bent slightly forward, giving the idea of gazing on the masses below. The large gables on the south and west sides are surmounted with groups on pedestals representing Engineering, Commerce and Agriculture. The figures are bold in execution, and most suggestive. The statue of H. I. M. The Queen-Empress in State robes has been placed under the canopy below the large clock of the central gable of the building, the statue is typical of the interests of the State in Railway enterprise, and the likeness of H. I. M. is pronounced to be good by competent critics. Two sculptured panels representing Trade and Science in full relief have been placed in the west side of the N.-W. and S.-W. carriage porches and are beautifully executed. The bold and massive piers of the entrance gates have been crowned with a colossal lion and tiger suggestive of the United Kingdom and the Indian Empire. The animals have been cleverly modelled and boldly executed. They are posed in a somewhat similar manner to Landseer's lions at the base of Nelson's monument in Trafalgar

Square, London. Between these is placed another central pier of rich design surmounted by a powerful handsome lamp. The circular panels between the arches of the west façade of the quadrangle are filled in with the heads, in full relief, of the present Viceroy, Lord Dufferin; the Governor of Bombay, Lord Reay; the late Sir Bartle Frere, Lord Dalhousie, Lord Elphinstone, Mount-Stuart Elphinstone, Sir J. Jejeebhoy, Colonel Holland, the Chairman of the G. I. P. R. Company and Mr. Watt, the Managing Director. These noblemen and gentlemen having been more or less connected with Railway enterprise in India, we believe it has also been proposed to add the heads of the late Messrs. James Berkley, C.E., and J. Sunkersett, the former having been the original designer of the P. I. G. Railway, and the latter having been one of the first Directors in this country. We would also suggest that the head of the late Director-General of Railways, General H. F. Hancock, R.E., be added, he having been the cause of many improvements on this and other lines of Railways, and the chief advocate for carrying out the scheme of the Great Victoria Terminal Buildings, a lasting monument that has marked the era of Railway enterprise in this Empire.

The buildings are faced with a light buff-coloured Coorla stone, having dressings, cornices, mouldings, enrichments, &c., in Porebunder and Seoni stones. The small domes and spires are constructed of Porebunder stone, while the large central dome is built partly of Seoni and partly of Porebunder stone. The arches and columns are varied in colour, the object aimed at by the designer being to give a brighter and more cheerful effect to the elevations than is given to those of many of the modern Indian public buildings.

The ground-floor of the buildings was partly built by petty contractors and partly departmentally, but from the first-floor upwards by Messrs. Burjorjee, Rustomjee, Maistry & Co., of Bombay. The decorations were executed by Signor Gibello from the designs of Mr. Stevens, and Messrs. Muraglia & Co., of Bombay, supplied and fixed the beautiful coloured marble work. Mr. Stevens was ably assisted in this great undertaking by Mr. S. Khanderao, Assistant Engineer, from the commencement to the completion of the work, as well as by Mr. M. Janardhan, Supervisor, till May 1886. The sanitary and water-supply arrangements were carried out by Mr. M. Smith, the Company's Plumber, and native assistants under the direction of Mr. Stevens.

(To be continued.)

A MICROSCOPE ILLUMINATOR AND POLARIZER TO OBSERVE EXTREMELY MINUTE OBJECTS.

III.

BY G. DUBERN.

Fig. 4.

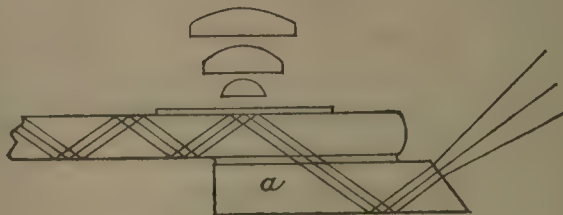


Fig. 4. shews a design to obviate the necessity of having each microscope slide with a bevelled edge. *a* is the section of a piece of plate glass fixed to the stage and over which the object slide is placed. Contact between both is produced by a drop of liquid in the intervening space. It is also very commodious to have the condenser fixed to the stage and adjustable by racks and pinions for both a vertical and horizontal motion.

A short practice only is needed to acquire skill with this illuminator. The splendid relief obtained by the

IA • TERMINUS •

IBAY •

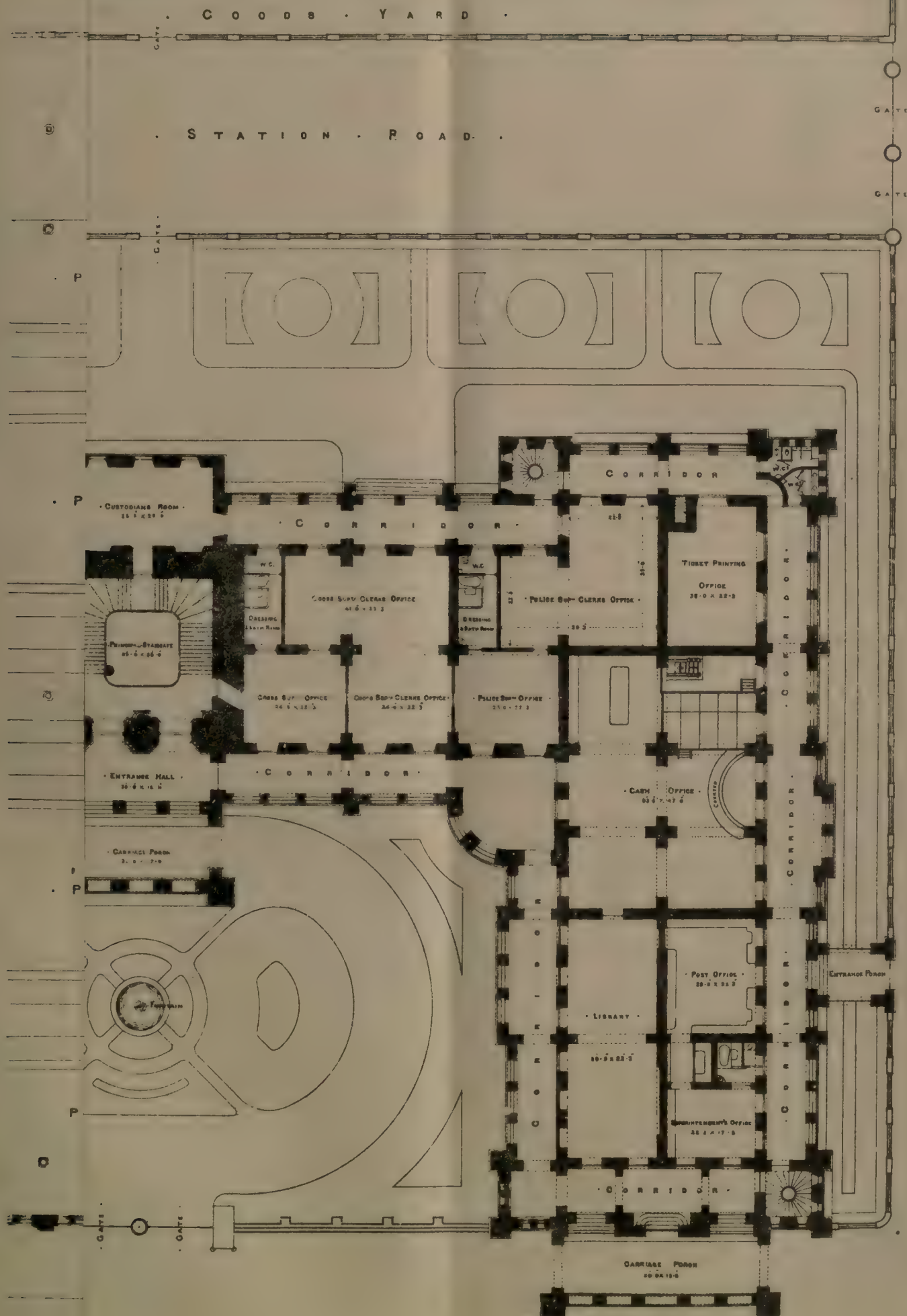
Published by the

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BOMBAY • MAY • 1887 •

• GOODS • YARD •

• STATION • ROAD •



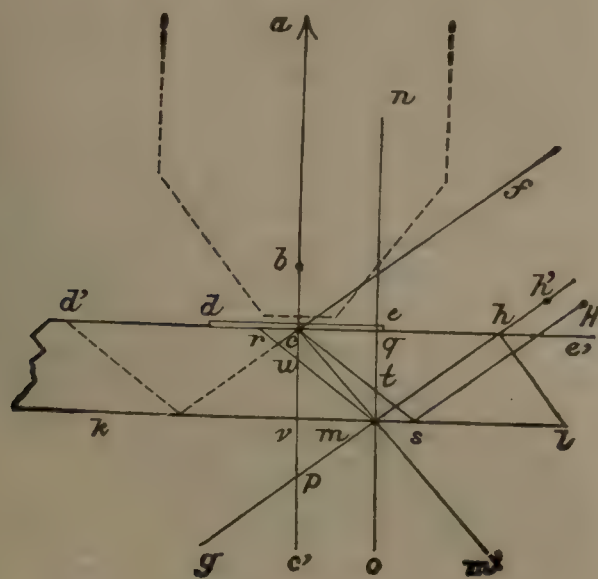
binocular microscope relatively to the one got at with the usual field lighting is of great help to fix ideas concerning what is seen. With the $\frac{1}{4}$ " objective, it is nothing short of the stereoscope effect on photographic views. With the $\frac{1}{8}$ " objective the rapidity with which objects in different planes get out of focus begins to destroy the nature-like appearance of objects and reproduce a picture-like one. However, it is as yet superior to the $\frac{1}{4}$ " and usual field lighting.

Polarised lighting, and simply very oblique lighting, can be alternated by altering the angle of incidence whilst observing and watching the transition and effect on objects. Mixed lighting, *i.e.*, the novel style at its best, together with a *little* sub-stage lighting from the mirror, for instance, to observe blood corpuscles in serum, need be tried but once, if successfully done, to raise the microscopist's enthusiasm to the highest pitch at the apparently magical revelation and sight of that which there was but a trace just an instant before.

Monochromatic lighting, either blue, red, or yellow, and finally white, can be tried in succession by simply sliding about the focussed rays under the object cover.

Another most useful lighting to check the accuracy of observations is to set the lit spot so as to have half of the field lit and half of it in the dark, *i.e.*, to observe the edge of the lit spot. This gives all gradations of light tones, from full bright white lighting to darkness, with intermediate zones of red, yellow and blue to choose from: slanting of the lens may be used to increase or diminish these colored zones.

Fig. 1.



By setting the light condenser at such distance that the focussing of rays be produced at *c*, *fig 1.*, after reflection from the surface *m s*, instead of being situated somewhere on the path of rays from *h* to *s* or from *s* to *c*, an incandescent lighting of objects may be produced without the slightest inconvenience to the eye, as the general field is barely as bright as when lit from a white cloud and with the concave mirror. Yet it is not the "clear field," as there is not the whitish back-ground of the usual general illumination; neither is it the "dark field," as darkness of field or back-ground is not present. It looks as if one's eye was in the midst of the liquid under observation, and looking around as in a sunny mid-day. This last is the most scrutinising lighting and should be used to see the half-millionth inch atoms in entirely clear liquid. They then appear like clear white specks whilst the larger ones are glittering with dazzling light, but not in any uncomfortable way to the eye, possibly from the fact that the larger being nevertheless so small, though intensity of light is very great, the quantity is too small to be resented by the eye: as on the whole very much toned-down light reaches it. The half-millionth atoms are not always present, but the five or six

times (diameters) larger ones always are. Diverging or converging rays are also a useful sort of lighting, easily attained by moving the light condenser backward or forward, so as to have the object either closer to the lens than the focal length, or further from it than that length. Definition is best when the lit spot on the glass cover surface is about the same size as the one at the lower surface of the glass slide, the rays are then parallel to each other. Incandescent electric light has given extremely poor results, and the strongest kerosine burners nothing at all with this illuminator. Arc light at a short distance with good condensing lenses is the only one besides the sun to give good results; but very likely the lime light (oxy-hydrogen) would prove successful. To shew life atoms and animalcules at their best with this illuminator a good binocular microscope must be used. The one experimented with is a Beck's one with Wenham's design of prism, this last being about one inch and a half from object lenses. The power best suited for general observations is from three to four hundred diameters amplification. Blood corpuscles shew best with eight hundred diameters, say with one-eighth inch objective. Those who will try the herein described way, and who have for a long time used the better class of microscopes and the higher powers, will find that excepting the relatively large objects, say the five-thousandth of an inch ones, that they barely saw besides that, one-tenth of what there is to be seen.

This statement I consider justifiable from the fact that nowhere is it mentioned yet, in the most recent microscope books, that (whatever they be) myriads of glittering specks, as plain as stars in a clear night, have been seen in the clearest distilled water, clearest and purest acids, in limpid serum, etc., etc. But the so called bacteria germs seen under great difficulties with the $\frac{1}{15}$ " or $\frac{1}{16}$ " objectives are no doubt the very life atoms herein referred to as seen most distinctly with the very much lower power of the $\frac{1}{4}$ " objective or even with the 1" one.

If observers will also examine in the same manner filtered solutions of coloring fluids *before* they add them to other liquids in which it is intended to search for bacteria, through coloring them, it may be their intention of so doing will be set aside.

The $\frac{1}{15}$ " inch objective, *i.e.*, from fifteen to sixteen hundred diameters power and very thin mica covers, is the highest ever tried in connection with this style of observations. A single life atom may, with some patience, be very well seen, notwithstanding its rather troublesome transit across the field. But the smallest ones are far too lively to have hitherto admitted of separate observation with such high powers. Whilst observing the larger ones they occasionally cross the field as if rather slow shooting stars with zig-zag and quivering motion.

In conclusion, whatever be the nature or real denomination to be given to the herein styled "life atoms," there is besides that, the fact that the described method and instrument at the very last computation, renders microscopic investigations ten times more searching.

This, in combination with the fact that it is possible to avoid the use of coloring materials in researches on germ and lowest grades of life and so leave them alive and in their natural state, increases by twenty-fold the probabilities of the microscope revealing the apparently mysterious primary causes of diseases, but of which there is hitherto but a vague suspicion.

P.S.—Since the above has gone to print the new illuminator and a power of 1500 diameters has shown the blood red corpuscle cellular or granular all over. It is most difficult to manage the required lighting to see that plainly and accounts for the fact of having seen hitherto only the periphery as such. There is now but very little room left for doubting that these very life atoms, are the universal architects of all organic products: this new illuminator detects them in any liquid or organic body either in the mobile or still state.

NAGPUR WATER-WORKS.

THE WORKING OF THE SCHEME.

IV.

9. PLATE IV. gives a very clear idea of the increase in the distribution system, the black lines representing the pipes originally laid down, and the red lines the extensions since 1872. The portions coloured red are the high parts of the City, which can only be supplied very inadequately in the early part of the cold season, and not at all in the hot weather months.

10. In the face of the facts above quoted, it is difficult to offer any explanation on the non-increase of consumption. It may be that the city supply is such an insignificant factor in the total loss from the Reservoir that the increase is almost imperceptible. It may be the same number of people drew formerly from the pipes as draw now, walking a further distance and using the standards a longer time.

Or it may be the discharging power of the pipes were strained to their utmost from the very commencement, in which case no amount of extension would tend to cause an increased consumption.

Water-rates & Private Consumers.

The water-rates charged by the Municipality are as follows:—

(i.) The G. I. P. Railway Company, who have a 5" branch, pay a lump sum of Rs. 1,200 a year.

The Ice Factory also pay a lump sum of Rs. 140 per annum.

(ii.) When water is taken by meter measurement, there are two rates, *viz.*, Re. 0-3-6 per 1,000 gallons for large consumers, and Re. 1 per 5,500 gallons for small consumers. The latter being calculated at the estimated consumption per head of 15 gallons for 365 days.

(iii.) For private consumers, who have taps in their houses, the rate is Re. 1 per head per annum for one bibcock and for every additional bibcock Re. 1 per annum for the whole household. The minimum rate charged for any one house is Rs 5 per annum.

The first year the works were opened, there were 48 private taps, and after they had been in operation 6 years this number had not quite doubled.

From this period, the number of private consumers increased rapidly, and at the end of 1886-87 there were 384 on the register. The average increase for the past 5 years has been 45 annually.

Cost and Maintenance

1. The cost of the maintenance of the works year by year is given in Table No. 9. The amounts spent on original works are also shewn and the income received from water-rates.

It will be seen, that a sum of Rs. 57,436 has been spent on extensions and improvements since the works were opened in 1872. The original cost, was Rs. 397,000 and if the amount spent in original works since the opening be added, *viz.*:

... ..	57,436
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2. The total capital expenditure is ... Rs. 4,54,436 The cost of maintenance including Establishment is almost constant, and the average for the past 5 years is Rs. 7,747. This is equivalent to a percentage on the capital outlay of only 1.7.

3. The income from the water-rates has been steadily increasing year by year and now amounts to Rs. 6,024. The works are therefore almost self-supporting.

4. The amount originally borrowed for the works was Rs. 3,77,000, which was to be paid off in instalments. There still remain two instalments to be paid amounting in all to Rs. 47,935 and the debt will be finally cleared in 1889-90.

5. In the completion report of the works, it was stated that the total cost was Rs. 3,97,000 and the inhabitants of the City numbering 84,000, it was calculated, that the water had been supplied at the rate of Rs. 4-11-8 per head.

It was, however, admitted in the paper read before the Institute that 10,000 yards of piping remained to be laid to render it a complete scheme. It may now be granted

that distribution pipes have been laid to all parts of the City that can be supplied, and, as above stated, the capital outlay on original works amounts to Rs. 4,54,436, and taking the same population, the real cost per head of the complete scheme is Rs. 5-4.

E. PENNY,

Executive Engineer, Nagpur Water-Works.

CALCUTTA INDUSTRIES.

SHALIMAR STEAM ROPE WORKS.

THIS important factory for the manufacture of rope and cordage of all descriptions is situated in a beautiful wooded estate at Shalimar Village, three miles from Howrah, and is the sole property of Messrs. Ahmuty and Co. It is bounded on the North by Bhurpara Village, on the South and East by the River Hooghly, and on the West by the Seebpore Government Workshops. The enclosed ground is of a considerable area, and the buildings, including stores and offices, over 200 fathoms in length. The factory communicates with Howrah by the Grand Trunk Road on the West, and the Shalimar Branch Tramway of the Port Commissioners on the East. To facilitate easy transportation of their cordage to the shipping, a canal 50ft. in breadth is excavated, which is, however, being gradually filled in by the silt or sediment of the Hooghly. The "works" on an average find employment for over 500 hands.

The building itself may fairly be considered to be on its "last legs," and with an outlay of about Rs. 3,00,000 it could be renovated and the supply of machinery and plant doubled. The nature, quality and quantity of outturn is somewhat unsatisfactory, comparatively, owing to want of far more suitable machinery and steam power. The factory possesses *one* horizontal non-condensing engine and *one* beam engine working alternately at about 40lbs. steam pressure.

All fibres used,—coir, Western India, Bengal and Cuttack hemp, and Manilla fibre,—have to be imported, as none are cultivated in close vicinity of the factory. Wire has also to be imported for the manufacture of wire ropes.

The factory is capable of supplying 100 tons per month cordage to the Ordnance and Marine. Cordage manufactured vary from the smallest fishing-line to about 42" cables.

The "works" are confined to the following plant and machinery:—

I. *Spinning Machinery*:—

2 Large Hackling-Machines.

2 Drawing Machines.

10 Automatic Spinning Machines.

By Messrs. Todd and Referty, New Jersey, America.

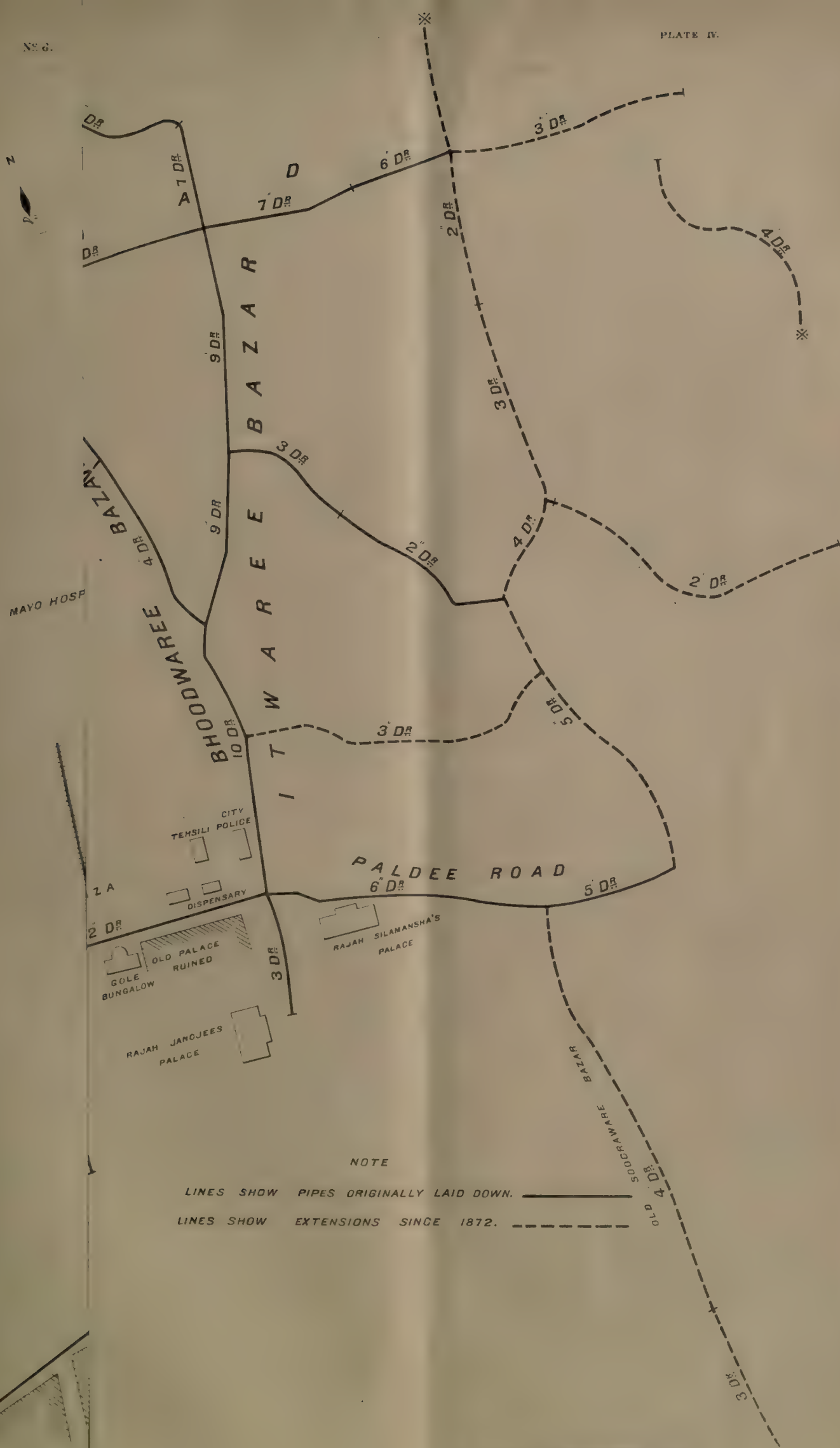
II. *Rope Walk Machinery*:—

One large and one medium forming machines, 2 large fore and two large aft laying machines for cables from 12" to 42". Also 2 medium fore and 2 medium aft laying machines for ordinary cordage.

The *Line Machinery* consists of 4 high speed machines of 12 hooks each and spinning machines sufficient for the employment of 60 hand spinners with their proper proportion of hacklers. Also a screw bulling dress.

A brief description of rope manufacture, as carried out at the factory, may not be out of place:—The fibres of hemp which compose a rope, seldom exceed three and half feet in length on an average; they must therefore be twined together so as to unite them into one, which is effected by the mutual circumtorsion of the two fibres. If the compression thereby produced be too great, the strength of the fibres where they join will be diminished, so that it becomes a matter of great consequence to give them such a degree of twist as is essential to their union.

The spinning is carried out both by men and machinery. That performed by the former takes place in a shed of considerable length, where a number of "whirls" (generally twelve) fixed in a semicircular frame receive a rapid rotatory motion from a belt or strap passing over them and a wheel fixed in a frame, to which motion has to be



NOTE

LINES SHOW PIPES ORIGINALLY LAID DOWN.

LINES SHOW EXTENSIONS SINCE 1872.

imparted by manual labor. The point of the prolonged axis of the whirl is bent into a hook, on which the end of the fibre is hung for spinning. Each spinner carries around his waist a bundle of hemp (which has been previously hackled or combed on sharp pronged steel needles in the ordinary manner pursued in jute factories), and fastening an end on the wheel hook he walks backward down the walk, giving out even proportions of fibre all the while and regulating his pace so that the amount of twist communicated to the *yarn* is uniform. He draws the fibre from his waist with the left hand and lets it slip between the thumb and finger of the right, which, protected by a piece of thick woollen cloth, compresses and moulds into cylindrical form the *yarn* as it is spun. At intervals in the length of the walk there are posts and rails supplied with hooks, into which the spinner throws his *yarn* to keep it off the ground.

The process of preparing the fibre and *yarn* by suitable machinery is far more interesting. The raw material from the bales is passed on into large hackling machines, where the fibres coming in contact with a cylindrical surface having prongs inserted into it, are distorted and drawn out into fine fibres. From these they are passed on to the drawing machines where on being laid in flat sheets and in sufficient quantities at a time, pass between cylindrical rollers, whereby they are drawn out and compressed into a broad thin ribband, which is next gathered and delivered by two other rollers into a can, ready for spinning. The fibre thus far being ready, is delivered on to the automatic spinning machines, which by suitable mechanism spin the fibre and deliver them on to bobbins in a form known as *yarn* ready for the "formation" of strands.

In "forming" the strands, the bobbins delivered by the automatic machine are placed in a suitable frame, the yarns off which are conducted through a concentric circle of holes in a steel *register plate*, and passing through a trumpet-mouthed tube, which varies according to the diameter of the strand, are connected to a single or more hooks on the *forming* machine. The machine travels down the rope walk on rails moved by an endless rope passing over a grooved pulley and guide pulleys, the hooks being at the same time set in rotation by gearing connected with the pulley. Three strands generally are needed for the formation of rope. If the yarns are to be *tarred* they are done before passing them through the register plate. This plan of tarring, however, weakens the strength of the fibre employed.

The three strands thus formed are "laid" or twisted together into a rope, for which operation they are attached to the middle hook of the "*tackle board*" and then placed in the grooves of a conical block of wood called a "*top*," through which passes a pin for the handles or "*woolders*." *Tops* employed vary with size of rope manufactured. Accordingly as the rope is twisted at the smaller end of the top, it therefore recedes owing to the resultant pressure of the strands, and thus a continuous supply of strand is obtained until the rope is finished.

The twisting of three strands together in the manner described forms what is termed a *hawser laid rope*; this is called the *first lay*. The *second lay* is performed with four strands producing what is known as *strand hawser laid*. The four strands are laid in the same manner as the three and under the same conditions, but, in order to render the rope more soild, a *core piece* consisting of a few yarns is run through the centre. The *third lay* or *cable laid* rope consists of three hawser laid ropes, each formed of three strands twisted or "laid" together into one gigantic rope or cable.

In conclusion, it may be added, that the factory on an average manufactures 1,200 tons annually at a mean value of Rs. 400 per ton, under the sole management of Mr. W. Mitchell, to whose energetic abilities, and the suitable staff employed, notwithstanding its many disadvantages, the factory has attained its present footing.

S. M. G.

ARTESIAN BORINGS.

SINCE my articles on the above, which appeared in your issues of 30th July and 13th August 1887, the Canning boring has gone down to a depth of 285 feet without any change as to the nature of alluvium which is still running sand. The water has been plentiful, and generally stands at about 3 feet from the surface. The drawback experienced in getting a regular supply is the choking up of the tubes by the sand, consequently the friction is increased and the water takes long to flow up.

When I had sunk about 265 feet, I tried an experiment. This was by putting into the bore a small hand lift pump, the suction being placed 30 feet below ground level. I found this did not act well, as the capacity of the pump was more than the spring could supply, and hence as soon as the water level got below the suction I had to wait till it rose again. Finding this not satisfactory, I determined on lengthening the lift 100 feet, thinking that by doing this I might reach the required depth where the hydrostatic pressure of the spring would be powerful enough to overcome the friction of the sand in the tube and flow freely, as it would be relieved of about 43lbs. to the square inch. Experiment No. 2 seemed to answer very well, and I was in hopes that I had succeeded, when on the fourth day the tubes began to choke again to such an extent that I gave it up and was forced to go deeper and wait till I reached another aqueous sheet, which I felt convinced must be met with sooner or later.

The work is still proceeding, but I regret to say that owing to continual ill-health, brought on by malaria, I have been obliged, by medical advice, to resign my appointment. I regret this, inasmuch that the work has not yet been accomplished to my satisfaction; but I hope my successor, whoever he may be, will carry it on and bring it to a successful termination.

I think this article will be incomplete without some information as to the cost, mode of work, and the type of machinery required for undertakings of this kind. Allowing the Canning boring as a data, we have in 10 months sunk to a depth of 285 feet. The question arises, Is this satisfactory? My answer is:—It is, and it is not. It is good work taking into consideration the amount of running sand cut through, and that the whole depth was sunk by manual labor. But on the other hand, it is far from satisfactory, and better results would have been shewn if steam machinery had been used, or even the rope system by hand. The mode of work in this well has been explained in my former article. This method I myself would not have adopted if I had been consulted in the matter, but as the plant was already purchased when I arrived I had no alternative but use it.

Opinion is so divided as to which of the two, (*viz.*), boring by rods or by rope, is the best. Some Engineers prefer rods, others the rope. The objection against the latter is that you cannot get a true circular hole, but I think this has been contradicted by the successful depths attained, and I myself prefer the rope, for not only being cheaper, but quicker work can be done. Some American Engineers use rods made of ash or other light tough wood, in lengths of 30 @ 40 feet, and this is also done by French Engineers, but I think it will be found that at present the rope is mostly used, and superseding the rods.

I shall now give an idea as to the expenditure in sinking a well 600 feet on the rope system. The best type of machinery to use in this work is one of Pierce's portable boring machines. In this the whole gearing, including boiler, engine, drums, rocking beam, &c., &c., are carried on a frame work placed on wheels, and can be removed from place to place either by a couple of good strong horses or 5 or 6 hardy bullocks.

The cost of one of these to sink 600 feet is about Rs. 5,000.

Estimate.

Cost of sinking a well 6" diameter reduced to 5" 600 feet deep, the well to be tubed from top to bottom with wrought-iron tubes screwed with flush joints.

	Rs.	As.	P.
1 Boring machine by Pierce, including all charges for erection, &c., &c. ...	7,000	0	0
600 feet of tubing, 6" x 5" ...	2,000	0	0
Cost of sinking a well 15' x 8' @ Rs. 2 per foot ...	30	0	0
Brickwork for stemming in ditto, including cost of platform, boring beam, fixing of girders, &c. ...	250	0	0
Cost of 2 wrought iron girders 12' x 18" and also 2 hydraulic jacks 30 tons ...	500	0	0
Wages of fireman and coolies engaged for 8 months ...	400	0	0
Engineer in charge @ Rs. 500 for 8 months ...	4,000	0	0
Cost of 120 tons of coal @ Rs. 12 per ton ...	1,440	0	0
Unforeseen expenditure ...	1,000	0	0
Total Rs. ...	17,120	0	0

or, say, in round numbers Rs. 18,000. As to the pay of the Engineer in charge, this depends upon the talent you employ. It is advisable in an important well to have a man of experience rather than trust to an amateur who might make a mess of the whole thing.

If there be more than one boring, the cost of the plant should be equally debited to each, which would reduce the expenditure on the single well; but if only one well is put down, the machinery could be sold and the proceeds credited.

The cheapest way for small towns with few inhabitants, who could not afford to go in for such an elaborate expenditure, would be the following:

Sink a well 4" diam, 250 feet deep, as an experiment first. This could be done by manual labor, and the whole affair would not cost more than Rs. 3,000.

You would require the following tackle, to be arranged as shewn in the diagram:

- 1 set sheer legs, complete with hooks, &c., &c.
- 400 feet of good hemp rope, 5" circuit.
- 2 shell pumps.
- 2 cutting chisels, weighing about 80lbs. each.
- 2 sucker bars, 10' x 2½" diameter, with 9" jars.
- 1 rocker beam with fittings.
- 1 crab winch.

Rope cutter, spear, extractor and other accident tools.

A well fitted with tackle for lowering tubes is shewn in the illustration.

300 feet of 4" tubes, wrought iron.

No extra charge is required to engage a specialist for a work of this kind, which could be placed under the supervision of the District Engineer.

I think the information given in the accompanying illustrations is sufficient to give an idea as to requirements and method of work.

The disadvantages experienced in India at present by those in search of artesian springs is the imperfect knowledge of the geology of the country, and this has been the real cause of the unsuccess of wells so far.

Before choosing a site for a boring, two things have to be considered, firstly the formation of the country, and secondly some idea as to the water bearing stratum you wish to bore to.

In England, where nearly every inch of the underground formation is known, it can generally be ascertained if a well will be a success or not. It is to the secondary or mesozoic beds that the Engineer there looks for their supply of water. These beds comprise the cretaceous, oolite and lias formations. The great water bearing stratum in England is the chalk, which belongs to the cretaceous group. The green sand also contains a plentiful supply, the water in which is more evenly distributed than the chalk. The oolitic limestone contains a good supply, but this bed is greatly cut up and disturbed.

In India practically nothing is known of the different strata of alluvium which Bengal is composed of, and theoretical suppositions are of no use as information. It is only the real knowledge of the ground that can be of use, and it is to the want of this knowledge that

a boring in an unknown country is fraught with such uncertainty.

Taking the average yearly rainfall of India to be about 96 inches, this will give us 3,803,788 gallons per square mile *per day*. The rivers, evaporation, and other sources take away most of this vast amount, but the water absorbed by the earth finds its way underground sooner or later back to the sea, or else remains stored up in some subterraneous stratum, and it is this water we must use our endeavours to obtain.

In conclusion, I beg to remark, "Don't stop important wells at depths of 200 or 300 feet if water has not been reached." It is the want of perseverance that has led to failure generally. In search for water, remember it follows the same laws below as it does on the surface. Another law which has been proved in practice is that should a 4" hole tap a spring, which gives, say, 20,000 gallons an hour, an 8" hole in the same stratum will give nearly 40,000.

English and French artesian wells are a standing example of what perseverance in this particular branch of Engineering can perform.

FRANK J. AGABEG, M.E.

PROPERTIES OF FLUIDS.

BY A. EWBANK.

X.

THE student who has read the preceding papers of this series and also those entitled "Principles of Mechanics" will be in a position to consider a problem of great interest, *viz.*, the floating of ships and their movements over the water as influenced by the action of the wind on their sails and the water on their rudders.

Fig. 15.

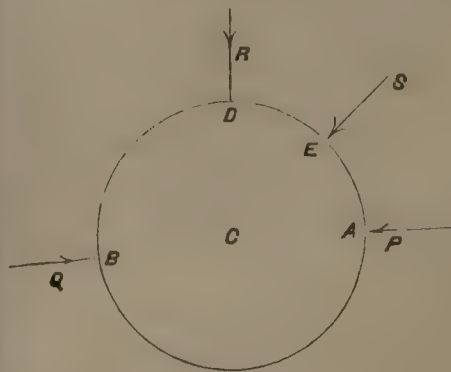
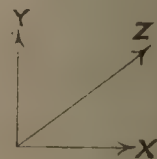


Fig. 16.



As a primitive boat let us consider a tub or round hollow vessel. Let this be floating at rest in still water. The *fig. 15* represents a horizontal section of the boat. The first question we may ask is what pressures does the boat receive from the water. The boat has itself a certain weight and as it is by hypothesis at rest, it must be supported by the water. A boat or other body placed on a hard horizontal surface touches this surface only over small areas of the surface. A body placed on a soft horizontal surface, such as a quantity of hay or cotton or wet sand sinks somewhat into the yielding material, and so forms what is called a bed for itself. When it has come to rest it receives over many small areas of its under surface a great number of small pressures. These must, when combined, be equivalent to some one resultant. This one resultant must be a vertical force Z. For if it was not quite vertical, but had, as in *fig. 16*, a slant or slope to the vertical, then this resultant Z would be equivalent, as we know by the parallelogram of forces, to some horizontal force X and some vertical force Y. Now, there is no other horizontal force acting on the body. That is, there is no force to neutralize X. Therefore, the body must, under the influence of X, have a tendency to move, and must actually move in some unknown direction, *viz.*, in the direction of X.

INDIAN ENGINEERING.

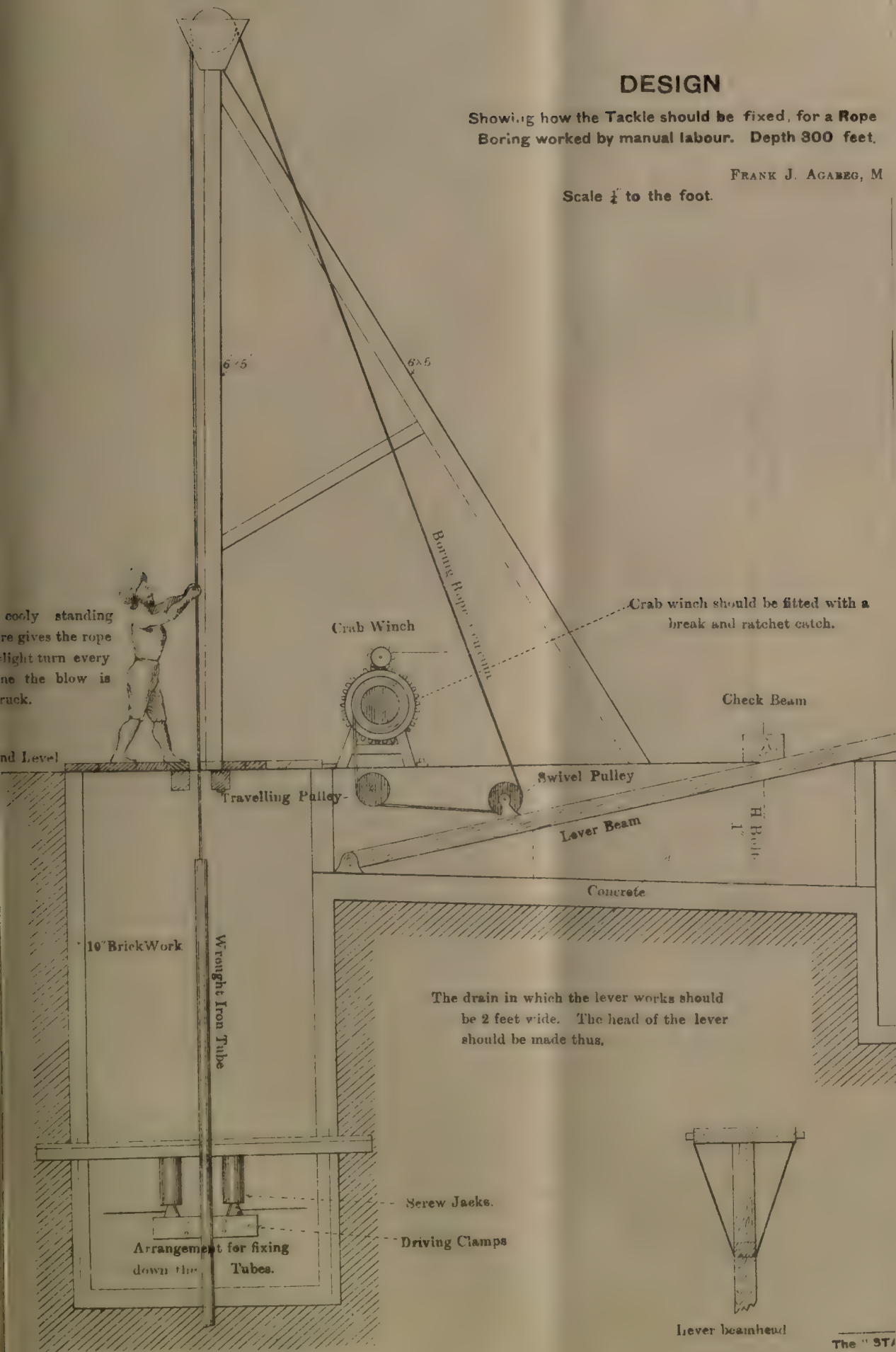
SECTION

DESIGN

Showing how the Tackle should be fixed, for a Rope Boring worked by manual labour. Depth 300 feet.

FRANK J. AGABEG, M

Scale $\frac{1}{4}$ " to the foot.



If, on the other hand, there is no component like X, as resulting from all the pressures on the supported body then the force is entirely vertical. If the pressures give a force entirely vertical, and acting upwards, this force may, in magnitude be exactly equal to the weight of the body. Unless this force Y is exactly equal to the weight of the body, the body must either rise or sink. Thus we arrive at the conclusion that if a body floats in still water, the pressures round it—acting over the surface immersed—must be equivalent to one vertical upward force whose intensity or magnitude is equal to the weight of the body. In *fig. 15* the forces, as shewn, appear all to be horizontal. But no system of forces can support a weight if all the forces of the system are horizontal. Thus *fig. 15* does not give us the complete system of pressures which act on a floating body and which serve to neutralise its weight.

Fig. 17.

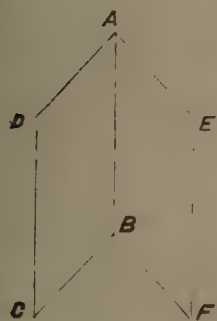
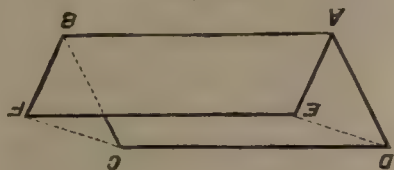


Fig. 18.



In order to illustrate the pressures on a floating body as supporting the body or neutralising its weight, we may conveniently take a body whose figure is a wedge. For instance, *fig. 17* represents a wedge-shaped piece of wood. Take a rectangular piece of paper—that is an ordinary sheet of writing paper, D A E F B C. This paper is already folded along a bisecting line A B. Hold the paper so that the angle D A E is some acute angle, say 30° . Then C B F is also 30° . Imagine triangles of paper D A E C B F to be pasted on. Thus we have a hollow wedge. If instead of ordinary paper we use wax cloth or tin or any water-tight material we may place the wedge with its edge downwards, as in *fig. 18* and fill it with water. The water makes what we will call a solid wedge. The vessel that holds it we have called a hollow wedge. Suppose that instead of water we have a wedge of wood which exactly fits into the paper wedge. This we call a solid wedge of wood. Such a wedge if made of light wood and placed in water might possibly not float with its edge or keel A B horizontal, and its upper surface or deck D E F C also horizontal. The keel might remain horizontal while the deck takes some sloping position.

If we return to our hollow wedge made of some water-tight material, and if we pour into it a little mercury, we shall find that the hollow wedge may be made to float with its deck D E F C horizontal. If we have a rectangle of paper or other material stretched over D E F C the deck becomes a real deck while originally it was only imaginary. Under the deck, we have an empty space *viz.*, a space containing air. Into part of this empty space, the mercury was poured. We may fasten on the paper deck before the mercury is introduced. In this case we may make several holes in the paper deck. The wedge then represents a boat or ship. The space once full of air, and now partly filled with mercury, we may call the hold of the ship. Through some of the deck holes we may imagine that we have fastened, or let in, masts to carry sails. At one end of the wedge, say at D A E, we may imagine a rudder attached. We have then a ship not intended by any means to go to sea, but merely to illustrate as a model some principles that we wish to discuss regarding water pressures and air pressures and the movements which a ship is thereby caused to take. If our model vessel floats or moves with its deck horizontal, we shall say it floats or moves on an even keel.

Fig. 19.

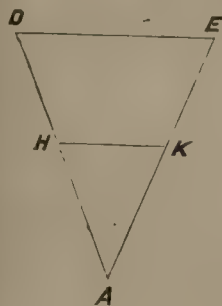
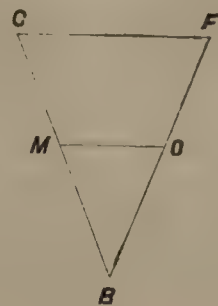
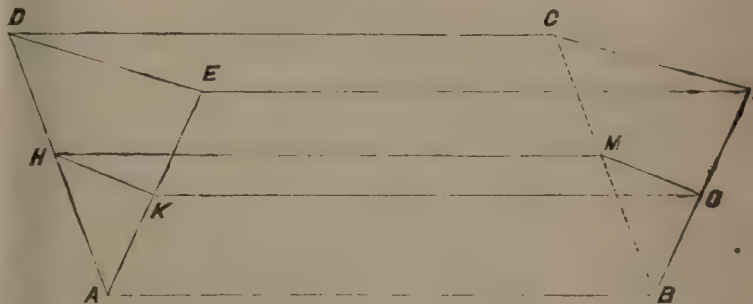


Fig. 20.



Let *fig. (19)* represent the vessel seen endways, so that D A E is the same triangle as in *fig. 18*. Then if the vessel floats on an even keel we shall have the line A D meeting the surface of the water in some point H. A E will meet the surface of the water in some point K. The line H K will be parallel to D E. Similarly *fig. 20* shews the other end of the vessel. In this end we have a line M O in the surface of the water.

Fig. 21.



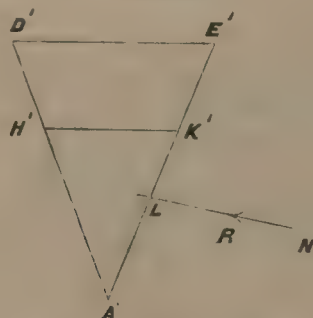
The *fig. 21* shews the whole vessel. Then H K O M is a rectangle in the surface of the water. The figure H K A B O M was a solid wedge of water before the ship was placed in the water. That wedge of water has been displaced to make room for the hollow wedge H K A B O M which is part of our model of a vessel. Here for simplicity we do not shew rudder, mast or sail. If when the vessel thus floats we add more mercury through one of the deck holes, we shall have the vessel sinking lower in the water. That is the lines A H, A K, B M, B O all increase equally and the volume of displaced water becomes greater. If we consider the faces of the wedge H K A B O M we see that we have two triangular faces which are in vertical planes, and two rectangular faces which are at a slope to the horizon. The fifth face is the rectangle H K O M but to this we need not make further reference, as no water pressures act on this face.

If the vessel is at rest and is in still water, we will assume that the pressures on the triangles H A K, B M O are horizontal. If the line H M or K O points due north, then the triangle H K A will have its vertical plane due east and west. The pressure on H A K we may consider to be a force in direction due north. Similarly the pressure over the area B M O is equivalent to a horizontal force acting due south. These pressures are exerted on the sides of the floating vessel by the surrounding water. If P be the pressure over H K A and Q be that over B M O we may put $P = Q$. One reason for putting $P = Q$ is that no reason can be assigned why P should be greater than Q or be less than Q. Other reasons could be given, but these other reasons might at this stage be imperfectly apprehended by the student.

We wish now to examine the pressures over the sloping rectangles A K O B and A H M B. The direction from A to B being still due north we have to describe perfectly or imperfectly the direction of the pressure of the water on A K O B. This pressure is not horizontal. If we consider

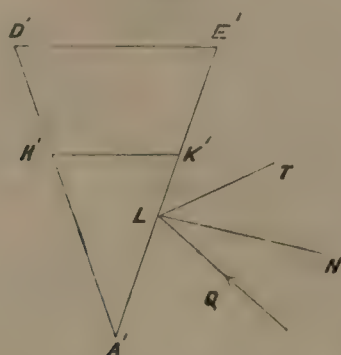
all the small pressures over the area $A K O B$ to be replaced by one equivalent pressure, we shall have a line of action such that this line produced either way cannot meet the planes of $A H K$ or $B M O$. When the student realises the meaning of this statement he will probably understand its truth. We may express the same thing otherwise, by saying that the whole pressure on $A K O B$ is parallel to the plane $A H K$. We might also say that this pressure has no northward or southward component; or we may say that this pressure acts across the ship, and not in any degree along the ship.

Fig. 22.



In *fig. 22* we give more particulars respecting the direction of this pressure. Here $D'E'A'$ represents any section of the ship parallel to the ends $D A E, C B F$. In this section and below the surface of the water take any point L . By L we mean not strictly a mathematical point, but a small area of the ship's side. Draw $L N$ at right-angles to $A'E'$. Then the pressure R of the water on this small area acts along the line $N L$. The line $N L$ is perpendicular to the plane $A E F B$. If the vessel were still more depressed in the water by pouring in additional mercury, or by any other cause, then at the moment the ship begins to sink it is not true that the pressure on L is strictly perpendicular to the ship's side; on the contrary the pressure on the small area at that moment is more correctly shewn in *fig. 23*. Here Q , the new pressure on L , is such as to give a normal component like R of *fig. 22*, and in addition to give some force parallel to $A'E'$ and acting upwards. This latter force is of the nature of friction. Its magnitude will partly depend on the liquid which may be clean fresh water or may be clean salt water or may be salt water mixed with mud or sand.

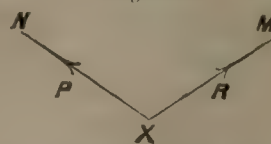
Fig. 23.



If some mercury could be suddenly removed from the hold of our model vessel, the vessel would begin to rise, and a new force S would act along some line like $T L$ of *fig. 23*. It is only when the vessel is absolutely at rest, and the water likewise at rest, that we may reasonably consider the force R to act, as is shewn in *fig. 22*. For our vessel thus at rest we have horizontal forces acting on the two ends of the vessel, and we also have sloping-upward forces acting on the two immersed rectangles $A K O B, A H M B$. And generally, if any plane surface be immersed in water or in any other liquid, the surface has from the liquid a pressure whose direction is normal to the surface, always provided that the surface is at rest, as also the water or other fluid that touches it. If we are asked why we assert that water pressure is thus normal to a surface

immersed, we may for the present reply that we learn the fact from experiment.

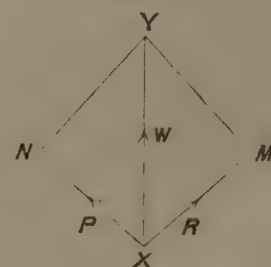
Fig. 24.



Returning to the wedge-shaped figure $A D E F C B$, of which $A' D' E'$ is a transverse section, *fig. 22*, we have four faces immersed. On the two triangular ends there are two pressures which are horizontal and which act in opposite directions along one and the same line. These forces destroy each other as far as the support of the body is concerned. Their only effect is to compress the body and this they do to some small extent. On the other two faces we have sloping-upward pressures. All the small pressures that act on the face $A K O B$ (*fig. 21*) are parallel forces. Their sum is denoted by P in *fig. 24*, where $X N$ is perpendicular to the face $A K O B$ of *fig. 21*.

Similarly all the pressures at the various small areas which make up the rectangle $A H M B$ of *fig. 21* give a sum R shewn in *fig. 24* as acting along a line $X M$, which is perpendicular to the plane $A H M B$ of *fig. 21*. These forces P, R are equal in magnitude, and the angle between them is the supplement of the angle $D'A'E'$ or $D A E$. If $D A E = 60^\circ$, the forces P and R act at an angle of 120° . These forces P and R are equally inclined to the vertical. The resultant of P and R is a force vertically upwards. This force must equal the weight of the vessel with its contents. Knowing the weight

Fig. 25.



of the vessel we can calculate the value of P as is shewn in *fig. 25*. Draw $X Y$ vertical to contain as many inches, or other units of length, as the weight W of the vessel contains pounds. Draw the line $X N$, which is parallel to the line of action of P , and draw $X M$ for the line of action of R . From Y draw $Y M$ parallel to $X N$ and $Y N$ parallel to $X M$. Then the equal lengths $X M, X N$ give in inches (or other units) that number of pounds' weight which denotes the pressure P or R .

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

XXX.

Setting ridge of tiled roof in lime mortar.

Items per 100 r. ft.	No. or Quantity.	Rate.	Amount.	Total.		
(1)	(2)	(3)	(4)	(5)		
<i>Labor.—</i>						
Masons	No. ...	1	Variable.	Do.		
Do.	" ...	1½				
Coolies	" ...	1				
Do.	" ...	3				
Bhistie	" ...	½				
Grinding Mortar, c. ft.	10					
Sundries						
<i>Materials.—</i>						
Lime dry powder, c. ft.	4·8					
Sand	" " "	4·8				
Surkhi	" " "	4·8				
Ridge tiles including waste	no. ...	125				
Sundries	...	.....		
Petty Establishment	.....	.....		

NOTES FROM HOME.

(From our own Correspondent.)

The ferry works at Woolwich and at Greenwich are making progress. The first of these is being constructed by the Metropolitan Board of Works. The latter is destined to mark a new departure in the conveyance of all classes of road and rail traffic across the Thames. An illustrated description of the design for regulating the approaches to the boat was given in *Engineering* of 17th February. The working plant consists of two steam boats, two landing stages, and four travelling platforms, together with the necessary engines, winding gear, &c. The landing stages are rectangular as are also the travelling platforms. The effect of the design is to gain access to the ferry boat from the roadway, the river bottom sloping gradually, and the tide rising and falling 20 feet. With the rise and fall of the tide the distance which the ferry boats can approach the bank varies to such an extent that a moveable landing stage has been designed to always remain with the same deck level above water. This stage together with two travelling platforms are moved up and down an inclined way 348 feet long sloping riverwards at a gradient of 1 in 10. Four lines of way run longitudinally down the way with a gauge of 4' 8½" and 11' 3" centres. Each travelling carriage is carried on 24 steel wheels 18 inches in diameter fixed under bogies, and so arranged on pivots that the weight is evenly distributed on each. On each side of the river just behind the abutment walls two cast-iron cylinders are sunk close to each other to a depth of 145 feet below the levels of the roadway. These cylinders are for the purpose of wells in which weights will be worked to act as counterpoises to the travelling carriages and landing stages. Sufficient engine power has been provided to overcome the inertia in moving these platforms, and also any additional weight of traffic which they may carry.

Dr. Marcet, the President of the Royal Meteorological Society, delivered an address at the Institution of Civil Engineers on the 21st instant on "Atmospheric Electricity" illustrating it with some interesting experiments. The address was followed by the reading of a paper by Mr. G. J. Symons on the Non-existence of Thunderbolts, the object of which was to abolish the common use of the term as a fiction unworthy of modern knowledge, the author stating that there is no more transmission of a thunderbolt in a storm than there is actual transmission of material substance when a message is sent across the Atlantic. An investigation into the circumstances of recorded thunderbolts left no doubt whatever of the fallacies involved in the statements made current. Everyone should help to drive the word out of use by investigating such statements when made, and giving publicity to the results. After these papers were read, the meeting adjourned to the Library and adjoining rooms, where a large and most interesting collection of apparatus connected with atmospheric electricity had been brought together, and amongst which particularly noticeable were numerous photographs of lightning taken during various storms. Amongst the instruments shewn as new since the last similar exhibition of the Society, were a very simple form of portable barometer and Colladon's instrument for illustrating the formation of water spouts.

With the object of shewing the kind of European architecture which is being put up in India, the *Builder* gives an illustration of the Town Hall, Meerut, in the North-Western Provinces of India. It is stated that the establishment of Municipalities in the cities and chief towns of India has given an impetus to the construction of these Municipal buildings. The Town Hall of Meerut was designed by Lieutenant Kunhardt, R.E., and cost about £10,000 including grounds, entrance gates, &c.

The Association of Municipal Engineers held a district meeting last week at Maidstone, where they were received by the Mayor and Corporation. A paper was read by the Borough Engineer on the Sanitary improvements of the town during the last ten years. A visit was paid to the sewage outfall works on the Medway where the filter presses by Messrs. Drake and Muirhead were inspected. These presses are worked by direct pressure pumps and not by compressed air, thus effecting an economy, and the intermediate discs of the presses are of matting of coir fibre, a material found to be more lasting and more efficient than canvass or jute cloth. The next district meeting of the Association is to be held at

Lincoln where works of local interest will be visited, described and criticised.

It appears from the recent reports of the Newhaven Harbour Company that very little more dredging requires to be done to insure sufficient depth of water to allow the *Dieppe* and other steam vessels to enter and depart from the harbour at all states of the tide. An extension of the breakwater 160 feet has been completed. About 135,000 tons of mud and sand have been dredged and removed from the harbour and channel during the half-year.

Some astonishing results are reported from Belgium concerning lethobrite, a new patent safety blasting powder. Unlike ordinary blasting powder or dynamite, lethobrite never explodes by concussion or rubbing, but when ignited and only in a perfectly closed room. The safe action of this explosive has been illustrated by the fact that in Belgium lethobrite has been used in the crowded thoroughfares of large towns in order to remove foundations of old buildings and other stone work without stopping the traffic for a minute, as by its action nothing is projected into the air as the material is simply displaced. Among its advantages, the gases caused by its explosion are harmless, and do not injure the health of the workmen.

In the death of Mr. T. E. Harrison, the Chief Engineer of the North Eastern Railway, the Engineering world has lost one of its leading members and shining lights. Mr. Harrison was a Past President of the Institution of Civil Engineers, and as a Railway Engineer occupied the highest rank. He remained in full active work up to the time of his death, which overtook him in his eightieth year.

A paper by Mr. P. W. Willans on Economy trials of a non-condensing steam engine simple, compound and triple was recently read and discussed at the Institution of Civil Engineers. The paper was illustrated with numerous drawings and tables giving the results shewn in the paper.

NOTES FROM SINGARENI.

(From our own Correspondent.)

On Tuesday, the 3rd April, Sir Charles Elliott, the Sirdar Dilar Jung, W. C. Furnival, Esq., all prominent Railway officials and a large force of *attachés* visited the Singareni Coal-Mines. Most of the party went below ground, the uninitiated expressing wonder at the quantity of fuel exposed, and the experienced declaring confidence in the ultimate success of the coal enterprise.

The various operations of the Hyderabad (Deccan) Company are said to be proceeding towards definite results.

At the collieries extension is proceeding as fast as local hand labor will permit, but as that is considered by some to be a very slow process in India, the hopes of the Management are centred on the Heading Machines, which have arrived, and which it is expected will be applied in two or three weeks. The information coming with these machines is, that they are equal to a yard of heading per hour.

More modest results, if realized, will have a strong bearing on future colliery extension in India. A full description of the machinery and its work will be forwarded for the benefit of your readers.

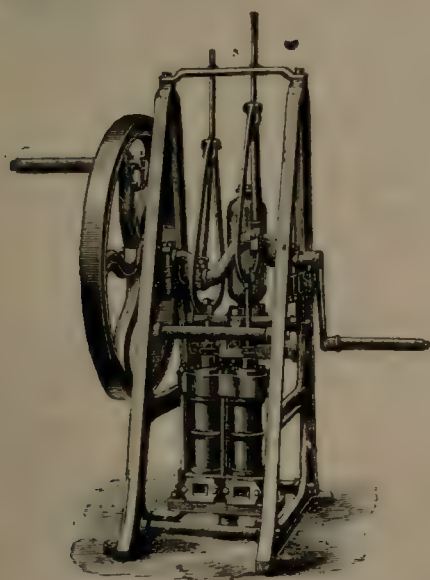
It is now generally accepted that the Hyderabad (Deccan) Company have struck not "oil," but gold in paying quantity about fifty miles west of Raichur. A good proportion of the prospecting staff are down in that quarter, and there are rumors of mining operations being commenced forthwith.

Good reports are also current respecting the mica mines.

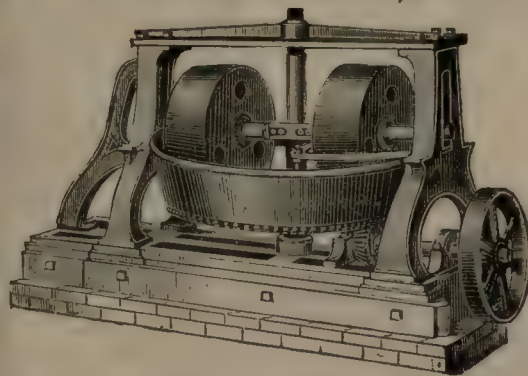
At the Diamond Fields, Partyal, a serious vacancy has been made in the staff by the death of Mr. Fred Freeborough. He was an old Kimberley pioneer, thoroughly acquainted with his work and a most genial companion.

[We glean from other sources that "it is not known what opinion the Public Works Member formed of the working of the mines, but the output of 25 tons a day, considering the time the mine has been open, or rather work resumed, and the fact of 50 tons per diem being the figure some six months ago, appears to be remarkably small. In the event of the company not finding gold or diamonds, will the coal-fields ever pay them is the question that naturally suggests itself. It is understood that the want of activity and life struck those who went to observe; matters seem as they were months back, which should not be, and pointing to something being wrong; and the sooner affairs are put on a proper footing the better for those shareholders who may be looking out to sell."—Ed., *I. E.*]

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4. The vessel will be at the risk and charge of the purchaser from the date the acceptance of the tender by Government is communicated to him.

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Where built	...	At Blackwall.
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Do. breadth	...	20 feet 8 inches.
Depth	...	11 feet 1 inch.
Number of bulkheads	...	Three.
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Engines	...	Two side lever disconnecting surface condensing.
Boilers	...	One multitubular.
Horse-power indicated	...	137.
Do. nominal	...	75
Coal that can be stowed in bunkers	...	66 tons.

6. The vessel will be open for inspection at Calcutta on applying for an order to the Deputy Director of India Marine on or after the 30th March 1888.

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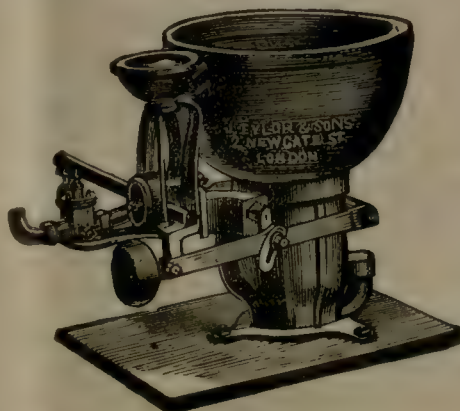
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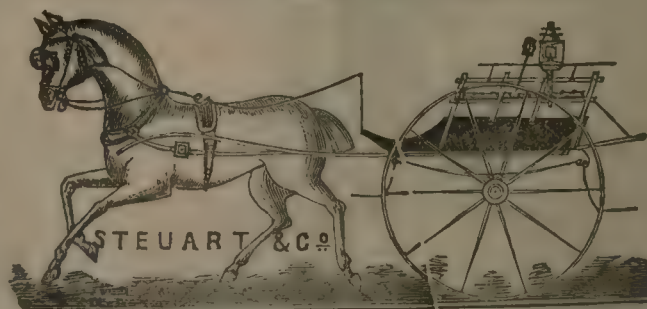


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Obituary.

LINTON.—At Calcutta, on 18th April 1888, Alfred Frederick Linton, late Chief Engineer, I. G. S. N. Company,—aged 44 years.

SMITH.—At Byculla, Bombay, on 16th April 1888, John Smith, P. W. Inspector, G. I. P. Railway,—aged 69 years.

INDIAN ENGINEERING.

SATURDAY, APRIL 28, 1888.

P. W. RE-ORGANIZATION.

II.

UNDER the existing organization of the P. W. Department promotion is so slow that officers do not rise to administrative appointments until they are between 45 and 50 years of age. Such a system is equally prejudicial to the interests of the State, and to the officers concerned. At present, men as a rule, only reach the higher appointments when they have already got into a groove, when it is too late for them to become good administrators, and when the faculty for originating and creating has commenced to subside; by the time they become Chief Engineers their zeal and energy have diminished, and feeling their official careers drawing to a close, they are inclined to let things drift and to wish to rest and be thankful! Some remedy for such a state of things is imperative, and it necessarily lies in either making promotion by severe selection, or in constituting a *corps d'elite*, the members of which would necessarily rise rapidly. There are objections no doubt to either proposal,—the first is liable to degenerate into promotion by jobbery; the latter leaves those who do not belong to the select service with but small hope of advancement. On the whole, however, we consider that the Commission has chosen the best and most economical way out of the difficulty.

The chief objection we see to the Imperial service is that as it will be comparatively small in numbers, consisting of only some 350 or 400 men at the outside, it will be necessary that all should be on one list, and that promotions should be made by the Government of India. This means that the promoting authority will know little or nothing personally of the relative merits of the men between whom it has to judge; and will probably necessitate advancement by seniority up to some fixed point. Another drawback to promotion resting with the Government of India is the delay which is likely to follow in giving steps. At present the Government of India makes promotions in the Railway list, and the result is, that although many have been due for a considerable time, none have issued for ten months, and if rumour is correct, a considerable time is likely still to elapse before they are out. As, therefore, promotion will probably rest with the Government of India, we consider that it will be absolutely necessary either that the Imperial branch should, be re-graded on some more simple plan, or else that the India P. W. Secretariat should be remodelled, for otherwise, matters will come to a deadlock, and grave discontent will naturally result.

The Imperial Branch is to consist "of such a number of Royal Engineers as may be required as a reserve for military purposes over and above the officers employed in the Military Works Branch, and of Civil Engineers recruited in England." We quite approve of this proposal as regards Royal Engineers, for it is absolutely necessary

that there should be a reserve of them in India, and Public Works is the most suitable sphere for their employment in times of peace. All we would suggest is that they should be so employed that their experience will be likely to prove useful to the State in war; for this reason we would exclude them from Roads and Buildings and Irrigation, and concentrate them on Railways. We also consider that the number should be strictly limited to what is necessary as a reserve for military purposes; and should not be unduly increased; otherwise a large number would have no chance of military employment even in times of war; and further the number of Civil Engineers would be so reduced that it would become impracticable to keep up suitable arrangements for the regular supply of properly educated men. At present it is well known that the number of R. E's is above the military requirements, for when the construction of State Railways was undertaken, the Royal Engineers were increased in excess of the military needs; and have never since been reduced. We trust, therefore, that if the proposals of the Committee be carried out, that Government will decide on and make known the number of Royal Engineers considered necessary to be retained in India, for military purposes, and as a reserve; and that that number will not be allowed to be exceeded. It is also necessary that the proportion of Civil Engineers in the Imperial Branch shall be such that there shall be no risk of the service being unduly dominated by the military element. That system had a protracted trial in the past, and was abandoned because it failed.

FORESTRY IN MADRAS.

II.

RED tape seems to be set a good deal of store by in forest administration in the Madras Southern Circle. And yet we find the Conservator complaining in his last year's Report that although two years have elapsed since the introduction of the Forest Code its provisions are not even yet thoroughly understood and acted up to in several districts. Perhaps there are too many of them. The Report, however, attributes the fault in great measure to the inefficiency of the District Office Staff, which is starved in the matter of pay. The Conservator, it is written, inspected *all* the District Forest Offices—except those of North Arcot, Madura, Tinnevely and South Coimbatore. A fairly wide margin of exception. But everything seems to have had to give way to the urgency of getting office papers sent in with the due amount of red tape cleaving to them, and much difficulty has been experienced in this matter. Nevertheless, good work has been done by the Department. 1,015 square miles of country have been settled as reserved forests, natural and artificial reproduction have been well cared for, some departmental surveys have been accomplished. Nothing, however, has yet been decided with regard to the organization of a Special Forest Survey Party, although the pressing need for forest maps is fully recognized. *Apropos* of surveys, here is a suggestive passage:—Almost the whole of the other districts in this Circle are stated to have been topographically surveyed by the Madras Survey

Department on the one-inch scale, but it appears that the work has not, as a rule, been checked by competent superior officers, and the maps are therefore more or less inaccurate even when published. Colonel Sargeant admitted this when he came to look into matters, and it is believed that steps are being taken to check and revise the maps, but the Survey Department like our own is very short of officers.

Comment would be work of supererogation. With survey work more progress has been made in Trichinopoly than in other districts, and that work has afforded one more striking instance of the importance of survey operations, the previously estimated areas of two of the forests, *viz.*, Minnakardu and Ponjantangi being found to differ widely from those ascertained by actual survey. Survey of the Padugais on the left banks of the Cauvery and Coleroon rivers was continued during the best part of the year under review by the Survey Department; but the work was then put a stop to, owing, says the District Forest Officer, to want of funds, and orders to defer any detached surveys, in the interests of the general scheme. Always when Government has a financial screw to manipulate it is some Engineering establishment or some establishment thereto affiliated that has to suffer. In Walayar, several surveyors and demarcators, assisted by the Forest Ranger, were employed in dividing the two blocks of the Walayar reserved forest into compartments and sub-compartments, and in demarcating out the blocks of sheet rock, and small patches of Irular's cultivation. But they all got stricken down with fever, and the work was in consequence badly done, and will have to be done over again to some extent. *Apropos* of preliminary working plans for the Chinnar Working Circle, it is remarked that those needed for the treatment of high forest are naturally much more complicated than those for coppice, or plantations. A platitude of course; but just one of those platitudes one is often in danger of forgetting or ignoring. In the Kilminnel District, North Arcot, 38 acres of land "washed away by floods" have been reclaimed, and made available for use. It would be interesting to have some particulars of the *modus operandi* of this reclamation.

Generally speaking, it is held that working plans are now the main, the essential want of the Department; and it cannot get them because it is undermanned. As the Conservator puts it:— "Much progress has not been made, owing to District Forest Officers and their subordinates having their hands full with the selection, settlement, and demarcation of reserved forests in addition to their routine duties." The moral of that would seem to be that a special Survey Department is what is needed. Routine duties can never leave a Forest Officer very much time to spare for extra work. By the way, we note that the average charge of a Divisional or District Forest Officer is about 4,700 square miles, of which sum total about 530 square miles are actual forest, under the special charge of the Department. The average range charge embraces 1,019 square miles, of which 115 miles at least are actual forest. The average beat of a Forest

Guard is about 20 square miles of forest. Obviously such areas as these are far too extensive for proper, efficient supervision. Obviously too, as forest operations increase, the unsatisfactory results, the ill-effects of such undermanning, must be more and more felt. Generally, it may be stated, that, under Mr. Brandis' scheme of organization, Forest Range Officers are in charge of all the woodlands and tree growth within the limits of their range, and have to travel all over it, to assess the value of trees, collect seigniorage, check permits, &c. In all grades of the Forest Department men have large charges, wide responsibilities. Too large. The numerical force is much in need of strengthening; and the prospects of its members ought to be bettered too. It ought not to be forgotten that they make the operations of their Department financially successful, even in this land of constant financial deficit. They have a fair claim to a fair share of the profits. They would increase, given a sufficient establishment. Meanwhile, let those in authority read, mark, and learn what the Conservator has to say on the subject. As in this paragraph for instance:—

"General protection has continued to improve, but will not be complete until we have a stronger and better educated professional staff to guard and work the reserved forests in a rational manner."

Here is a passage from the Report, the moral of which seems to us unanswerable:—"In the same district (South Arcot) 5,930 head of cattle were impounded during the year for trespassing in areas closed against grazing and the 'pound fees' collected have been ascertained to amount to Rs. 560. The bulk of those cattle are, it is believed, foreign herds from Tanjore and elsewhere which have been accustomed to roam at large and devastate the forests. Every endeavour is made to warn the herdsmen to avoid closed areas, but apparently with little good effect. Great difficulty is still experienced in protecting the Trichinopoly plantations (reserved forests) from the inroads of semi-wild cattle which destroy the young trees. The Conservator has been in frequent communication, verbal and oral, with the Collector and District Forest Officer on the subject, and it is proposed to prosecute the owners and herdsmen under section 21 (d) of the Forest Act after giving them due warning to adopt reasonable precautions to prevent trespass. There is still a tendency on the part of the magistracy, especially in Malabar, to deal very leniently with forest offenders. This is a fault in the right direction in the case of petty offences in ill-defined areas, but it is otherwise in the case of deliberate breaches of the law in reserved forests legally constituted and clearly demarcated by pillars and boundary lines."

In North Arcot, where 2,485 acres were burnt by a forest fire, its genesis is attributed by the local Forest Officer entirely to the failure of the north-east monsoon, the grass being thereby induced to dry very early, before precautions could be taken to isolate the specially protected areas, and adopt proper precautions inside. The head of the Department does not hold with this view, believes rather that there must have been carelessness

on the part of the Department in burning off the fire-lines. And he says, in that connection:—"District Forest Officers and Range Officers will not commence their fire-protection in time, or understand that complete isolation must be secured and free entry prohibited *before* the grass becomes readily inflammable." Without extreme and constant care a Government preserve is very apt to suffer for the shortcomings of neighbouring owners of trees. The whole of the private forests in the neighbourhood of Renigunta, Chandragiri Taluk, were ablaze when the Conservator was there in February, and the danger to the Government forest was great.

Colonel Walker holds that even light grazing on steep hill slopes is inimical to natural reproduction, and the retention of forest and soil in their normal and satisfactory condition. Nevertheless, in consideration of popular inclination in this matter, we suppose, free grazing was allowed in North Coimbatore to about 60,000 head of cattle, and in South Coimbatore grazing has been practically permitted over the whole area of reserved forests, with the exception, on the one hand, of fire-protected portions, and on the other of goats and buffaloes. In Salem no fees were levied during the year, nor were any restrictions placed on cattle grazing in other than fire-protected areas. Everywhere attempt seems to have been made to avoid friction with either real or supposed grazing rights held by the people. Arrangements were initiated by the Conservator under which grazing privileges, when admissible in reserved forests, will be secured to neighbouring cultivators in the first instance. In the fire-protected areas natural reproduction is progressing favourably. Hopeful indications are most apparent in districts from which cattle have been rigidly excluded.

In Malabar (Wynaad) 30lbs. of *Ficus elastica* seeds from Assam were sown in the beds in the botanical garden, and in the nurseries at Kanot. In the latter 1,100 plants were successfully raised. 2,000 mahogany seeds were also sown in Kanot and 800 plants raised; but not more than half of them were alive at the close of the year. It is suggested that the site is probably too high and exposed. One cutting of the golden Burman bamboo planted out is doing well.

The Conservator considers the results of the year's working as, on the whole, satisfactory. The collections of timber were considerably in excess of those for 1885-86. Here is a comparative inventory:—

DESCRIPTION.	COLLECTED DURING		ISSUED DURING		DIFFERENCE IN	
	1885-86.	1886-87.	1885-86.	1886-87.	Collection.	Issue.
Teak C. ft.	16,993	22,509	17,395	20,714	+ 5,606	+ 2,819
Teak saplings .. No.	53,641	49,966	54,391	285	- 3,675	- 54,076
Blackwood .. C. ft.	685	913	2,472	2,973	+ 228	+ 501
Vengai and other miscellaneous timber C. ft.	46,278	22,383	44,022	50,077	- 23,805	+ 6,055
Red sanders .. Tons.	121	50	217	50	- 71	- 167
Sandalwood .. "	23	11	60	14	- 12	- 46
Firewood .. "	1,683	1,517	1,641	1,430	- 166	- 211
Bamboos .. No.	20,170	33,998	20,275	26,212	+ 13,828	+ 5,937
Minor produce .. Tons.	14	27	25	26	+ 13	- 1
or approximately in Tons	6,800	6,100	7,000	3,200	- 700	- 3,800

NOTE.—The excess under "issues" over "collection" was from stock of previous years.

Notes and Comments.

ATTEMPTS TO DERAIL TRAINS.—An epidemic of this sort of amusement seems to have broken out all over India.

CHEAP MATCHES.—Japan is making rapid strides in the adoption of foreign machinery for turning out cheap matches, over 1,200,000 crop of this useful article valued at 300,000 dollars were exported during the last year. We have always believed that there is room for a like industry in India.

RECLAMATION OF LAND IN NORTHERN EGYPT.—An interesting work is about to be commenced in Northern Egypt. It is proposed to reclaim from the sea an area of land extending over 31,000 acres, and for this purpose works and steam pumps have been already established at Aboukir. The enterprise will be commenced forthwith.

RUSSIAN PETROLEUM.—The *Odessa Messenger* states that India is becoming one of the largest consumers of Russian petroleum in the world. In 1887 more than 2,000,000 poods were exported from Batoum for that destination, and in January alone of the present year as much as 400,000 poods were shipped at that port for the East Indies.

THE OUDH AND ROHILKHAND RAILWAY BILL.—The House of Lords has passed the East India (Purchase and Construction of Railways) Bill, enabling the Secretary of State to raise the money for the purchase of the Oudh and Rohilkhand Railway, and to enable the Secretary of State to borrow a sum of money which would be a guarantee to the Company.

BOMBAY PORT TRUST.—The bye-laws for the regulation and management of the Wet Docks of the Bombay Port Trust, which have been duly sanctioned by Government, are published for general information in the last Official Gazette. The clauses are very comprehensive and evidently drafted with due regard to the various interests concerned.

"ARTESIAN BORINGS IN THE SUNDERBUNDS."—As the issues of this Journal containing the articles as headed above are out of print, and sufficient inducement having offered, we have resolved to re-produce the matter, with the additional information that appeared in last issue, in pamphlet form—to meet the requirements of District Officers and others in Bengal and elsewhere.

COAL PROSPECTS IN BURMA.—The authorities in Upper Burma have, we believe, received several applications from capitalists and others to be allowed to prospect for coal in the Province; and the question of granting licenses is being considered. In the meanwhile, we are glad to find that a well-known expert is now actively engaged in reporting on the coal prospects of Lower Burma.

GOVERNMENT WORKSHOPS, SEEBPORE.—This institution is evidently doomed. The initiative was taken by the announcement of the intended transfer of the Howrah buildings to the 2nd Calcutta Division, and now the transfer of Mr. Toogood, the Superintendent, to an Executive Division in Calcutta, and the placing of the workshops under a subordinate, would appear to be the death-knell of the latter.

AN ARCHITECTURAL SURVEYOR AND ENGINEER WANTED IN BENGAL.—Mr. Gwyther's transfer from executive work to the Office of the Chief Engineer for employment as Architectural Assistant points again to the necessity for the appointment of a specialist as Architect to the

Government of Bengal—one who could devote the whole of his time to the office under the usual incentives of remuneration and prospects.

BANGALORE WATER-SUPPLY.—The scheme submitted by General J. F. Fischer, R.E., for supplying Bangalore with water, will be brought up before the Board at its next ordinary general meeting to be held on the 28th instant. As this scheme is most likely to be adopted, we are induced to give General Fischer's report elsewhere, which is considered by many to offer the best solution as yet of a difficult problem.

A MERITORIOUS OFFICER.—We learn that Rai Prosuno Coomar Bannerjee, Bahadur, one of the senior subordinates in Bengal, and an Honorary Assistant Engineer, has obtained a further extension of service till August 1889. This native gentleman is well known as an amateur gardener, and has for years held charge of the Eden Gardens and the Calcutta maidan, which bear evidence of his taste and special ability.

WANTED, A PRACTICAL MAN.—An "Executive" on the Bombay side advertises for an expert who will be capable of personally superintending and directing up-country the skilled labor in a Workshop, and also the ordinary P. W. D. Works of a Military Station. The suitable man will be taken on as a Sub-Overseer, 1st grade, on the Temporary Establishment, and the employment will probably be continuous on rupees fifty a month.

THE BENGAL-NAGPUR RAILWAY.—We learn that works between the Damuda River and Asansol have commenced, and likewise the Colliery Branch Railway. Brick-making for the Damuda Bridge is in active operation, and things generally along the line are considered lively and satisfactory. The foundations of the Bridge will be taken in hand November next. Rails and other plant are rapidly coming in and being distributed along the eastern section.

DARJEELING.—The P. W. D. is much exercised regarding a landslip at the hill sanitarium of Bengal. The mishap which occurred not far from the cemetery, though of small dimensions, raises the broad question of the stability of that side of the hill. Messrs E. J. Martin and Anley, along with some other officers, have been specially deputed by the Government to examine the spot, and report upon the measures which are considered necessary.

CEYLON PEARL FISHERY.—The Pearl Fishery has been closed within two months since its opening. The result cannot but be regarded as eminently satisfactory. The total number of oysters fished up aggregate 22,052,769, of which the Government share amounted to 14,701,846. The expenses are estimated to amount, in all, to Rs. 75,000, and, deducting this from the total receipts of Rs. 8,04,247-62, it will leave the Government the handsome sum of Rs. 7,29,247 as clear profit.

DIRECTOR OF MINES, HYDERABAD—DECCAN.—The Nizam's Government has at last taken the course long advocated by us in the appointment of Mr. Mirza Mehdy Khan, M.R.A.S., F.G.S., &c., to act as Government Director of Mines. This selection is a very appropriate one, as the technical training which Mr. Mirza Mehdy Khan has undergone both in England and Germany specially fits him for the duties of the appointment. He is, moreover, a distinguished Associate of the Royal School of Mines.

ARMY NEWS.—The following addition is made to the regulations for the appointment of Royal Engineer Officers

who elect for continuous service in India to the School of Military Engineering at Chatham:—It is to be distinctly understood that an officer who chooses to pass in India the prescribed examination for promotion to the rank of Major, will still be required to do duty at Chatham for eight months, in order to make himself acquainted with the progress made in military science and engineering.

GOOD INVESTMENTS FOR RETIRED ANGLO-INDIANS.—For a Directorship of a Company qualification is required, that is, shares to the amount of £200 or £300 to £1,000 have to be taken. In the "going," well-established Companies, Directorships are much sought after, and a great deal of interest is required to get on to one of these Companies. For an investment of £1,000, the Director's fees would be about £200 to £300 a year; in smaller Companies about £300 qualifies, and the remuneration is about £150 a year.

OUR RANGOON ITEMS.—Through linking of rails on Toungoo-Mandalay extension. The report in the *Pioneer* that this work had been completed is premature, as through linking of the rails is not expected to take place before 1st May. A serious accident occurred on this line at the 47th mile from Toungoo. Two ballast trains got into collision, killing 9 people and wounding others; the drivers and guards escaped unhurt. Mr. A. T. Dods-worth, late Executive Engineer, P. W. D., died at Rangoon on 17th April 1888.

E. I. R. BURRAKUR BRANCH EXTENSION.—We are informed that a Syndicate is in course of formation, under the auspices of Messrs. Bird & Co., to finance the proposed extension of the E. I. R. Branch Railway across the Burrakur towards the Jerriah coal field, which scheme the Government are not disposed to undertake. It is in contemplation in the first instance not to go beyond the Kudia River at Nirsha, about 5 miles from the present terminus at Burrakur. The work will be carried out by the E. I. R., the river crossing rendering this course necessary.

BOMBAY SEWERAGE.—It is satisfactory to find a writer, who has devoted twenty years to the study of such questions, of opinion that the double system of sewerage (which has been adopted in Bombay and in part carried out) has striking advantages for separating the sewage proper from the surface drainage, the only drawback being that of expense. But in Bombay the expense must be faced, seeing that the monsoon floods can only be carried in conduits of great capacity in which sewage would, and does during the dry weather, remain stagnant.

BURRAKUR PLOUGH.—Mr. M. T. Cox reports as follows on the Burrakur plough:—"I gave it a fair trial, preparing 3 bigas of land for a sample of Purple Straw Wheat imported from Melbourne. It worked well and satisfactorily, and the opinion of three of my native ploughmen who tried it, was that they preferred it to the 'Hindustan,' because, in using, it approached the Indian *Nagol* that they have always been accustomed to closer than the 'Hindustan.' In my opinion it is quite as good as the 'Hindustan' besides offering the advantage to the Planter of being so much cheaper."

TARKESSUR RAILWAY COMPANY, "LIMITED."—The Managing Agent's Eighth Report of the Tarkessur Railway Company, "Limited," for the half-year ending 31st December 1887, shews the gross revenue for the half-year to be Rs. 1,16,158-7-0, which is equivalent to an average earning per mile per week of Rs. 200-12-8. After providing for all charges, and after including a balance of

Rs. 1,856-3-5, brought forward from last half-year, there remains a net balance of Rs. 51,603-14-7, which will admit of a dividend of 3 per cent. for the half-year, and leave Rs. 2,103-14-7 to be carried forward.

NOT A WHITE ELEPHANT.—The Jubilee Bridge was erected mainly for the purpose of diverting part of the heavy downward traffic of the East Indian line to the Calcutta side of the river, but an unexpected development of traffic in the opposite direction is now, however, taking place, as consignments of produce from Eastern Bengal districts are beginning to arrive at Howrah *via* Naihati Junction and the Jubilee Bridge. From this it would appear that Howrah, despite its situation on the further side of the river, possesses advantages as a goods terminus which are not shared by Chitpore and Sealdah.

THE KOLHAPORE INDUSTRIAL EXHIBITION.—The Industrial Exhibition at Kolhapore was brought to a close on 12th April, with the ceremony of presenting prizes to the successful exhibitors. Colonel Hunter, C.B., C.S.I., presided. An interesting report, drawn up by the Honorary Secretaries, Messrs. Candy and Shannon, was read by the latter gentleman. The exhibition was visited by over 22,000 persons. Public interest was largely aroused in the subject of technical instruction and the improvement of local industries. Colonel Hunter expressed pleasure at the gratifying result of the first experiment of the kind here.

A GLOOMY OUTLOOK.—A correspondent asks:—It being pretty well settled that the Viceroy will leave India in August, and that Lord Reay is going to Simla to act as Viceroy till the arrival of Lord Lansdowne, how will this affect the Public Works Department in which so many changes are contemplated and pending? This inquiry arises from Lord Reay's recent action in regard to the P. W. D. of the Bombay Presidency; but there need be no apprehension of anything of the sort occurring under the Government of India, for the acting tenure will be too short, should it ever occur, for dubious changes or dangerous experiments.

THE BANNU RAILWAY SURVEY.—We hear that Mr. Ramsay has arrived at Rawal Pindi, and that the plans and estimates are to be made out this hot weather, and submitted for sanction. There are three alternative routes: one *via* Dera Ismail Khan; one from Khusalgarh at the terminus of the branch line from Rawal Pindi, and the last branching off from Khundean on the Sind-Sagar Railway, running to Mianwali and crossing the river between that point and Esa Khel or Kala Bagh, thence skirting round the hills to Bannu. The last will probably be the line ultimately adopted, as it is the most direct route from the Indus to Bannu.

PUBLIC WORKS DEPARTMENT.—A correspondent to a Madras paper is concerned to know if there is any rule limiting the time a Military Officer in the Public Works Department may be away on field service, retaining his footing in the P. W. D.? He is aware of a certain Royal Engineer Officer, who, of his own accord, sought field service, and left the Department over three years ago. That Officer is still on field duty, his name remaining on the P. W. D. list, for purposes of promotion. It is an open secret that he does not mean to return to the Department; yet, so long as his name remains on the list, he blocks promotion, even temporary. How long is this to go on?

TRADES MARKS AND DESIGNS COMMITTEE.—The Press Association understands that the Trades Marks and Designs Committee will probably conclude the r delibera-

tions this month. The Committee are of opinion that the Merchandise Marks Act is working admirably, and their report will, it is expected, contain a strong recommendation to the Government, not only to use their influence to induce the Colonies to enact similar safeguards, but also to bring diplomatic pressure to bear on foreign Governments with the same object. The report will also probably recommend that the system of registering Sheffield goods be extended to all branches of the hardware trade.

LOCAL MANUFACTURES IN CALCUTTA.—Messrs. McGavin, Smith and Co. have favored us with specimens of the locks made by Das' Chitpore Lock Manufactory, of which they are Sole Agents. They are made in several qualities, the best being in every way equal to Chubb's, and they can compete favorably in prices all round. Government are using these locks in several departments, and they give entire satisfaction. As an important local industry, this undertaking deserves public support, and we feel sure it has only to be brought forward to ensure for it the undoubted success it merits. Messrs. McGavin, Smith have also favored us with samples of Calcutta made paulins, rope (hemp and coir) and wire gauze and netting, which we find equal to anything imported into the country.

THE IMPERIAL FOREST SCHOOL, DEHRA DUN.—The interesting ceremony of the distribution of prizes and certificates to the successful students of the Imperial Forest School took place on the evening of the 21st ultimo at Phaudowala. Mr. W. R. Fisher, the energetic and able Director of the School, delivered an address, as usual, chiefly for the benefit of the students returning to their respective Provinces. Out of the 20 students in the Senior Ranger's class only ten obtained the Ranger's certificate; of the remaining lot, 3 are returning with Forester's certificates, 6 are remanded for another 3 months to improve their Forestry, and one has joined the Junior Ranger's class and will remain in the school for another year. No student gained this year the certificate with honors given only to students with exceptional merit.

OPINIONS OF THE PRESS ON OURSELVES.—The *Times of India* says:—We observe that INDIAN ENGINEERING this week contains an excellent drawing and description of the Victoria Terminus, Bombay. The plate brings out well the noble proportions and varied architectural beauties of the magnificent building with which Mr. Stevens has adorned our city. In the next issue of the Journal it is proposed to give the plans of the structure.—The *Evening News* says:—We have to acknowledge receipt of INDIAN ENGINEERING for 21st April. It maintains its reputation as being a most valuable Journal for members of the profession; and the printing and general get-up is second to nothing on this side of India, and does the Printer great credit. The present number contains among other lithographs an admirable ground-plan sketch of the new offices at the Victoria Terminus of the G. I. P. Railway at Bombay.

SEEBPORE CIVIL ENGINEERING COLLEGE.—Candidates for admission to the Engineer Department should apply to the Principal before the 25th May next. The session begins on Monday, the 4th June. Candidates must furnish proof that they have passed the Calcutta University Entrance Examination, and that they are under 19 years of age. This limit will be raised to 21 years of age in the case of candidates who have passed the F. A. Examination of the University. Ten scholarships will be awarded

to students entering the Engineer Department not being already holders of junior scholarships. The scholarships will be awarded *after admission* with general reference to the place taken by candidates at the Entrance Examination. Students who have passed the University Entrance Examination in April are eligible for admission to the Mechanical Apprentice Department up to the 4th June next. They must send in their applications before 25th May.

BUILDING REGULATIONS WANTED IN CALCUTTA.—A local paper, discussing the necessity for preventive measures for public safety in Calcutta, says:—It may be quite correct that the Municipality have no authority over buildings that do not threaten to fall into streets; but there should be some authority or obligation other than that of the occupiers to see to the stability of buildings, whether used for residential or business purposes. Tenants have not always the means of ascertaining the stability of buildings, and landlords have often a tendency to make the least possible do in the way of repairs. As the subject has been mooted, and as there is a Bill before the Bengal Council dealing with all matters pertaining to the welfare of the city, it would be well to take the opportunity of inserting some section in the bill that would no longer leave it open to the residents to be crushed in their houses, and no one either have the power to prevent such "accidents" or be responsible when they occur.

"AS OTHERS SEE US."—A Madras paper observes: "The Government of India has set its seal of approbation on INDIAN ENGINEERING in calling the attention of the Chief Secretary to the Government of Madras 'to the articles in INDIAN ENGINEERING, dated the 30th July and 13th August 1887, on the artesian boring in the Sunderbunds, in which a suggestion is made for the extension of such borings generally in India. They might, in the opinion of the Government of India, be usefully brought to the notice of the Committees of some of the larger Municipalities and of Local Boards.'—G. O., 15th November 1887, No. 2179L, Local and Municipal. The articles with the two illustrations accompanying them are also printed in an Appendix to the G. O., for the information and guidance of 'all Presidents of District Boards and Chairmen of Municipal Councils.' INDIAN ENGINEERING cannot get a more flattering certificate of efficiency than the testimony the Government of India is pleased to afford in this G. O."

DARJEELING-HIMALAYAN RAILWAY COMPANY.—The Report for the half-year ended 31st December 1887 discloses a very satisfactory state of affairs, the net earnings for the six months, after providing for interest on debentures, was Rs. 1,02,579-1-2, to which fell to be added Rs. 78-12-0, the amount of unclaimed dividends to 30th June 1884, and Rs. 10,347-7-10, the balance brought into the account from 30th June 1887, making the total surplus available for distribution Rs. 1,13,006-5-0. Out of this an interim dividend of 4 per cent. was paid in February, which absorbed Rs. 70,000, leaving Rs. 43,006-5-0 to be dealt with; and from this sum a further dividend of 2 per cent. has now been paid, making 6 per cent. for the half-year; Rs. 8,006-5-0 being carried forward to the Profit and Loss Account of the current half-year. Taking Rs. 1,02,579-1-2 as the net surplus revenue for the half-year, it is equal to 5.86 per cent. on the paid-up capital of Rs. 17,50,000 or at the rate of close on 11½ per cent. per annum, a profit on railway working which is more than satisfactory, being unequalled, we believe,

by any Rail-road Company in the world except by a small mineral line in Wales.

THE ABT SYSTEM FOR THE BOLAN.—We glean that the experiments recently made on the Bolan Ghât with the Abt system proving it to be practically a failure cannot be considered as conclusive. For purpose of experiment a length of 7 miles of Abt rack road and two Abt engines were got out from Germany at a cost of over four lakhs of rupees; the late Member for Public Works being determined to thoroughly test the system. This road was to have been laid on a gradient of 1 in 25 and would have more than sufficed for the length of the Bolan Ghât above Hirok, now being converted from metre to broad gauge. Sir Theodore Hope having left India, other counsels seem to have prevailed, and but one mile of Abt rack rail was laid down to experiment on. This is considered an inadequate length for trial of a locomotive engine. It is no test of steaming capabilities; and as the Abt engine boiler has to supply two pairs of cylinders, such a test is absolutely necessary. We hear rumours that Mr. Graff, the Austrian Engineer engaged by Colonel Wallace to lay this experimental line, has resigned, the management of these experiments having been so unpractical.

A RESOLUTION.—The present system of grading Subalterns of Royal Engineers on their first appointment to the Public Works Department with Civil Engineers, has been under the consideration of the Secretary of State and the Government of India, in connection with the question of the establishment of Royal Engineers to be retained in India.—2. The conclusion arrived at is, that under the existing system young Royal Engineer officers, whose service in the Department commences from the date on which they first join, are placed at a disadvantage in comparison with the Engineers appointed from the Royal Indian Engineering College at Cooper's Hill, who count service in the Department from the date on which they leave college, to go through a course of practical training, either in England or India.—3. After a full consideration of the relative ages at which the students of the Royal Indian Engineering College obtain their appointments and the Royal Engineers obtain their first commissions, it is considered that the two classes would be placed on an equality by allowing Royal Engineers who enter the Department as Subalterns after more than two-and-a-half years' military service, to count their service in the Department as commencing two-and-a-half years after the date of their first commission.—4. His Excellency the Governor-General in Council is therefore pleased to rule, with the concurrence of the Secretary of State, that Subalterns of Royal Engineers, appointed to the Department subsequent to the year 1872, when Engineers from the Royal Indian Engineering College first entered the Department, shall count their departmental service as commencing two-and-a-half years after date of first commission, unless the actual date at which they joined was earlier; provided that no officer shall add more than one year to his actual service in the Department under this rule.—5. In publishing this decision, the Governor-General in Council desires it shall be recognised in the Department generally that departmental seniority gives no absolute claim to promotion, since in the words of the Secretary of State's Despatch of 19th January 1888, the principle on which advancement in the Department is based, is selection for merit, the influence of seniority alone being of secondary importance in most cases.

Current News.

MATERIAL is arriving daily at Manickpore for the Manickpore-Jhansi section of the Indian Midland Railway.

On either side of the Jhelum Railway Bridge, the construction of bridge defence works has been taken in hand by the Railway authorities.

It is said on apparently good authority that £40,000 was expended in advertising the Hyderabad-Deccan Mining Company in England.

COLONEL FILGATE leaves for England in middle of May, and retires on the expiry of his furlough. Major Begbie succeeds eventually to his appointment.

A **SURVEY** for an irrigation canal in the Bhakkur district is well forward. The country neighbourhood is fertile, but want of water prevents cultivation at present.

The Bengal and North-Western Railway are still trying to get hold of the Tirhoot State Railway, and we understand Sir Charles Elliott has declared in favor of the arrangement.

The net Indian sea and land customs revenue, exclusive of salt revenue, for the official year 1887-88 amounted to Rs. 1,28,93,000, as against Rs. 1,20,32,000 in the year 1886-87.

COLONEL F. G. OLDHAM, R.E., Examiner of Accounts, Military Works, has, we hear, obtained six months' leave to England, and will be succeeded by Mr. J. B. Braddon from Calcutta.

TELEGRAPHIC news has reached Hyderabad that the shares of the Mining Company, which at one time touched £14, have dropped within the last few days to £7, and are still falling.

The question of building new Municipal offices in Bombay has at last been settled, the Corporation having decided by 20 votes to 11 to adopt the site opposite Bori Bunder Station.

MR. SYED ALI BELGRAMI, the Government Director of Mines, Hyderabad-Deccan, has been appointed to act as Home and Railway Secretary during the suspension of Sirdar Diler Jung.

COLONEL CONWAY-GORDON, the Director of State Railways, left Lahore for Quetta in company with Colonel Wallace, the Director of the North-Western Railway, to inspect the line.

We hear that, for the present, His Highness' Government does not propose to appoint a Director to the Mining and Railway Companies, as it is not considered necessary to fill the vacancy at once.

MR. W. H. WHITE, Executive Engineer, Morvi State, has been permitted, by His Highness the Thakore Sahab of Morvi, to spend Rs. 2,50,000 in six months on the extension of the Morvi State Railway from Wankaner to Rajkot.

SIR CHARLES ELLIOTT, Member of Council, Public Works Department, and Colonel Conway Gordon, Director of Railways, arrived at Lahore last week and were met at the Station by the Heads of Departments belonging to the North-Western Railway.

COLONEL J. STEWART, B.A., C.I.E., Superintendent of the Government Harness and Saddlery Factory, Cawnpore, who is now in Scotland on eighteen months' furlough, has expressed his intention of returning to India early in September next.

The Secunderabad Water-Supply project is being pushed on under the supervision of Major Fox, R.E. The roads through which the pipes are to be laid are being surveyed, and we learn that the work is to be taken in hand at no distant date.

Work in connection with the construction of the Chenab Bridge over the Ravi at Shere Shah has been commenced; the work is under charge of Mr. Bell, who has constructed the two great bridges over the Sutlej at Ferozepore, and Adamwhan.

From the annual report just issued for 1886-87, we gather that at the end of the year under review the area of the Sind forests was 699 square miles and 409 acres, a gain of 26 square miles and 203 acres over the area as it stood on the 1st April 1886.

A **THUNDERSTORM**, accompanied by a gale of exceptional violence broke over Mandalay last week. The iron sheeting from roofs of houses was blown about, while the famous spire above the Throne Room in the Palace was shaken like a reed and now remains bent.

We are very much astonished to hear that a telegram has been received here to the effect that only 3,000 out of the 12,500 shares in the Mining Company purchased by His Highness' Government are registered in the Company's books in London. What has become of the remaining 9,500?

THE construction of the great road from Dera Ghazi Khan to the Pishin is being rapidly pushed on. The cost will be about 8 lakhs when finished, but doubts are expressed regarding the possibility of watering and provisioning the transport should the road be used in time of war.

MR. DOUGLAS, Government Examiner of Accounts, East Indian Railway, has been appointed officiating Examiner of Accounts, Bengal, in addition to his own duties, as a temporary arrangement, in the place of Colonel Trail, R.E., Examiner of Accounts, Bengal, who goes on leave immediately.

COLONEL J. G. FORBES, Chief Engineer, Irrigation Branch, and Secretary to the Government of the North-West Provinces in the Public Works Department, takes charge, in addition to his own duties, of the office of Chief Engineer, Buildings and Roads Branch, in the place of the late Colonel D. Ward.

MAJOR DORWARD, R.E., On being relieved of his appointment as Commanding Royal Engineers, Upper Burma Field Force, has been directed to proceed to India; and Captain E. W. Dun, Deputy Assistant Quartermaster-General, Intelligence Branch, has been transferred to the Head-quarter Office at Simla in the same capacity.

FOR the past three years there have been no floods in the River Mulleer, consequent to the scanty rainfall; the result is that the water-supply of Karachi is seriously affected; but Mr. Strachan, with his usual energy, is devising means for bringing down a stream from a spot some seven miles higher than the existing wharf, to supplement the present very limited supply.

IT was proposed lately at Madras to levy a tax of one anna per gallon on all imported kerosine, but at a meeting of the Municipality last week it was decided that, as an alternative, a tax of one anna six pie per pound should be levied on all tobacco consumed in the city. The necessity for increased taxation has arisen from the large outlay to be incurred on water-supply during the year.

OWING to increasing traffic, the Madras Harbour Trust Board have tested, and are thoroughly renovating, the pier, under the superintendence of the Engineer of the Harbour Works. The whole structure is to be completely overhauled, and replanked closer than before. For the convenience of passengers two substantial teak siding ladders will also be substituted for the old rickety ones now in use.

THE Karachi Harbour defences are being pushed on very rapidly, and a large body of laborers are busy throwing up embankments and making the masonry walls and curtains. The Garrison battery have been encamped for over a month at Manora mounting guns, and soon their Barracks there will be put in hand. The harbor works too are progressing rapidly and the new ship wharves are in active construction.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

COKE ADULTERATION.

SIR,—I beg to endorse the views enunciated by one of your correspondents in the last issue of your Journal on the above subject, and in doing so I can support my position by the fact that Mr. Niveu's advertisement in the Calcutta dailies is the outcome of an unusually large stock of unsold coke at the Gas Works, the product of which is not able to hold its own in the open market under fair competition with colliery-made coke which is unquestionably superior in many respects to the former article.

INDIAN MINER.

MR. BLIGH'S FACTS AND FIGURES.

SIR,—Mr. Bligh, the author of "New Types of Cheap Roofs," says, in your issue of 24th September 1887, page 207, that "The East Indian rails are 5½ inches deep, have a sectional area of 1.9 square inches, and the value of I, the moment of inertia, is 24.7. The Vignole's rails are 4½ inches deep, 5.84 square inches area, and the value of I is 14.4." Now, the areas of the sections are very nearly as above stated, except that the E. I. rails have only 7.6 square inches. But the chief discrepancy appears to be in the values of I, which, as calculated from the actual cross sections of the rails, are very nearly as given below:—

	Values of I
E. I. rails	20.71
O. R. Rails	13.66

Will Mr. Bligh kindly enlighten us by showing how he arrived at the results given in the above extract; as in the case of their being over-estimated, the results deduced therefrom would necessarily be affected in the same proportion.

X.

A CRY FOR JUSTICE.

SIR,—From the conversation I had the pleasure of holding with you the other day, I could make out that it was evidently more owing to your want of a definite knowledge of the Native Engineers, that your views have formed such an unfavorable estimate of their capacities. The Native Engineers have all along done their work to the best of their abilities, and have as far as records shew proved themselves equal to their task.

They have got no kith and kin in the influential quarters of the official world, and that alone ought to convince an impartial judge that but for their merit they would have long ago lost their ground.

Times have now altered, and with the almost annual recruits from the high-sounding Royal Indian Engineering College, passed students who, because they happen to pass out of that Institution, are considered something like a set of super-human beings with double stars prefixed to their names in the Classified List, the Native Engineers in spite of their requisite knowledge are being considered as useless, and hence are getting neglected. They are as a rule afraid to make themselves conspicuous by protestations when they are outstripped by striplings by dozens of years their juniors.

If those that control power are obstinately bent upon making an abuse of it, by passing over the claims of the Native Engineers, it is not their fault. They are a weak minority, and, as I said before, cannot venture, through fear of losing even what they enjoy, to assert their claims. If matters were dealt out as they should, long before the world would have seen the late Kanhya Lal a Superintending Engineer or Babus Madhub Chundra Roy and Bhola Nath Dass far higher in the List than what they are now entered as.

The hue and cry lately raised from the evidence of some of the members of the superior grades of the service before the Public Service Commission, condemning the Native Engineers as a whole, are the outcome of a most unjust and one-sided conspiracy as it were. Reason and equity have given place to a feeling of jealousy as it were, to see the subject race walk on the same level with the ruling.

The present letter you will please understand is entirely a friendly one, meant to explain to you the position of the Native Engineers, which in my humble opinion is a very pitiable one. It is easy to judge others harshly, but not so easy to deal justly with them.

"In other men we faults can spy
With curious and sharp sighted-eye,
Each little speck and blemish find
To our own greater errors blind,
Ere we condemn another's sin
Let our own hearts look within."

If what I have written helps in any degree to create an impression, or tends to alter your pre-arrived conclusions with respect to the poor Native Engineers, I shall consider myself more than amply rewarded for all the time and labor I have devoted in this letter.

April 7, 1888.

R. N. B.

[Our correspondent has completely misunderstood our meaning. We have never deprecated indigenous talent and would like to see a larger scope given to its employment as occasion arises. But judging from the published reports of the Indian Engineering Colleges, are the results so hopeful as to justify Government to utilize more extensively the products of those institutions in the higher grades of the service? The passed students of Cooper's Hill College to whose recruitment in the Department our correspondent takes exception have had better opportunities of mastering their profession, with ampler experience than could ever be attained by an Indian pupil. The cases are not analogous and a comparison between the two would be invidious.—Ed., I. E.]

TABLES FOR ROLLED IRON BEAMS.

SIR,—I am sorry I have not been able, owing to indisposition and press of work, to send an earlier reply to Mr. Hodson's criticisms on my Tables. In my first article on the subject, I fully explained the method I proposed to adopt for the computation of these Tables, and yet for full five months there was not a voice against it. However, it is never too late to mend, and I must say, now that my attention is drawn to certain cases where my Tables do not give satisfactory results, that their application must be limited to certain ratios which I will presently explain.

At the same time I must add, that I never anticipated that the following practical considerations will be lost sight of in determining the section of a beam:—

(a.) That the flange should not be narrower than ⅓th of depth, or else the beam will not possess sufficient lateral stiffness without transverse bracing of some sort.

(b.) That the flange should not be wider than ⅓th depth, otherwise the section will not be an economical one.

(c.) The depth should not exceed ⅓th span, otherwise the web will not possess sufficient lateral stiffness, and the beam is likely to lateral disfigurement.

Within these considerations, I am positive that my Tables will always give accurate results.

Now, the illustrations selected by Mr. Hodson, go against one and all the above conditions. I don't complain of his action,

because I had, while doing the mechanical work of arithmetical calculations, inadvertently given figures for all sorts of sections up to $d = \frac{1}{8}$ th span.

That some such tables are wanted by the profession is clear from the demand for my Tables to which Mr. Hodson refers, and unless he or any other gentleman undertakes to supply us with better ones, I propose to revise the figures of my Tables for depths between $\frac{1}{8}$ th and $\frac{1}{4}$ th, up to which I will presently shew that they are quite reliable.

Mr. Hodson doubts the accuracy of Trautwine's formula and questions its applicability on the ground that it involves the assumption that the stress varies as cube of the span, whereas he thinks it should always vary as square of the span. In order to explain the above assumption, it is necessary to draw your attention to the theories of finding stresses on beams, and every work on Applied Mechanics distinctly lays down that there are two methods—(1) Transverse strain, which ensures that the beam is strong enough to carry the load; (2) Limit of deflection, which means that the beam should be stiff enough, so as not to injure its superstructure, and that the deflection is not so great where the law of elasticity will be no more applicable.

These two methods are quite independent of each other; in the former the variation is as square of the span, and in the latter as cube of the span.

In order that a beam should satisfy both conditions, namely, strength and stiffness, the problem should be solved by both methods, and whichever gives the safe results is to be adopted.

Comparison of deflection formula given in Stoney (1873 edition), page 178, with the transverse formula given in the same book, page 47, will satisfy your readers as to the reason of the variation as cube of the span.

Trautwine's formula adopted in my Tables is no more than ordinary deflection formula, with the substitution of moment of inertia by certain functions of area and depth.

Few words about moment of inertia, which Mr. Hodson thinks is merely a work of arithmetic to find.

I beg to differ. Mr. Hodson has given a method which, so far as his notations express, is based on the assumption that the thickness of web is equal to the mean thickness of flanges, which does not agree with practice. For the correct shape of girders let your readers see Major Cunningham's Applied Mechanics, page 215.

To find the moment of inertia of this figure correctly, when there is absolutely no data to be found in any of the catalogues, is not an easy matter, and for that reason I selected a formula which only requires the area and depth, area being easily computable by multiplying the weight in lbs. per foot by '3.

Let us assume Trautwine's method as sufficiently correct for stiffness and Stoney's formula for strength, which is as follows:—

$$S = \frac{Wl}{8ad^3} \dots \dots \dots (1)$$

Where S = constant
= 460 for rolled iron girders with flanges of equal area (see Stoney, page 48)

W = breaking weight
l = length in inches
d = depth in inches
a = sectional area in inches

Trautwine's formula as reduced in my first article (see page 239 of Vol. II of INDIAN ENGINEERING of 1887) was—

$$w = \frac{1350d^2}{l^3} \times a \dots \dots \dots (2)$$

Where w = safe load in lbs. per foot run
d = depth in inches
l = span in feet
a = weight of beam in lbs. per foot run.

To avoid confusion, let us reduce both formulæ to common notations and let us call

w = safe working load in lbs. per foot = $\frac{1}{3}$ rd the breaking weight for steady load (see Rankine's Applied Mechanics, 1876 edition, article 247)

L = length in feet
d = depth in inches
A = area in square inches

$$\therefore \text{ in (1) } W = \frac{3wL}{2240}$$

l = 12L

a = A

$$\therefore \text{ in (2) } l = L$$

a = $\frac{10A}{3}$

$$\therefore (1) \quad W = \frac{8 \times 460 \times A l}{12L} = \frac{3wL}{2240}$$

$$w = \frac{36 \cdot 8 \times A d \times 2240}{36 \times L^3}$$

$$= \frac{A d \times 2240}{L^3} \text{ approximately } \dots \dots \dots (3)$$

$$(2) \quad w = \frac{1350d^2}{L^3} \times \frac{10}{3} A$$

$$= \frac{13500 d^2 A}{3L^3} \dots \dots \dots (4)$$

In order to find the limit up to which each method should be used, equate (3) with (4).

$$\therefore \frac{A d \times 2240}{L^3} = \frac{13500 d^2 A}{3L^3}$$

$$\therefore \frac{d}{L} = \frac{1}{2} \text{ nearly, i.e., the proportion of depth to length is } \frac{1}{4}.$$

In other words, the strength formula will give safer results up to $d = \frac{1}{4}$ th, and the stiffness formula for depths of $\frac{1}{4}$ th and under; that is to say, the Trautwine method is applicable for depths = $\frac{1}{4}$ th and under, and for depths greater than $\frac{1}{4}$ th, strength formula should be used. The figures given in my Tables from $\frac{1}{8}$ th to $\frac{1}{4}$ th will therefore have to be revised. As soon as I can find time, I propose to send you revised tables giving the safe loads calculated by the transverse formula above explained up to $d = \frac{1}{4}$ th and retaining the present figures for $d = \frac{1}{8}$ th and under.

In the meantime I shall gladly welcome further criticisms, and especially with regard to the use of factor of safety 3 in the breaking weight formula, for which there is a good authority and which I consider enough for another reason too, namely, that the beams are supposed to be freely supported, while in practice the ends are always built in.

LAHORE; April 16, 1888.

GANGA RAM.

New Books and Reprints.

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Announcements.

By Messrs Crosby Lockwood & Son:—

The Mechanical Engineer's Office Book, By Nelson Foley. 2nd ed., much enlarged

Practical Surveying: A Text Book for Students preparing for Examinations or the Colonies. By George W. Usill, A. M. I. C. E., Author of "The Statistics of the Water-Supply of Great Britain."

The Mechanics, Workshop Handy Book: A Practical Manual on Mechanical Manipulation. By P. N. Hasluck, A. I. M. E. (A New Volume of Lockwood's Handy Books for Handicrafts.)

Waterworks: Being Notes of the Storage of Water in Reservoirs, the Construction of Embankments, Weirs, Stream Gauges, Rainfall, Conduits and Pipes, Domestic Water Supply, Pumping Engines, Service Reservoirs, Water Power, Water Wheels, Corn Mills, Rivers, Floods in Rivers, Conservancy of Rivers, County Boards, and Watershed Areas. By Charles Slagg, C. E. Author of "Sanitary Work in the Smaller Towns and in Villages."

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HUNT (T. S.) Mineral Physiology and Physiography; or, Geological and Mineralogical Studies. With a General Introduction. 8vo, pp. 700. Boston ... 25/

MINERAL Resources of the United States, Calendar Year, 1886. By David T. Day, Chief of Division of Mining Statistics and Technology. (United States Geological Survey.) Demy 8vo, pp. 813. Government Printing Office (Washington.) ... 50 cents.

PATTON (Jacob H.) Natural Resources of the United States. 8vo, pp. 523. D. Appleton and Co. ... 12/6

PRESTWICK (Joseph) Geology, Chemical, Physical and Stratigraphical. 2 vols. Vol. 2: Stratigraphical and Physical. Roy. 8vo, pp. 620. Frowde ... 36/

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The Building of the British Islands: A Study in Geographical Evolution, with Maps. By Dr. Jukes-Browne.

By Messrs. Crosby Lockwood & Son:—

A Treatise on Metalliferous Minerals and Mining. By D. C. Davies, F. G. S. 4th ed.

Asbestos: A Popular Account of its Properties and Commercial Uses, and of the Asbestos Mines of Canada. By Robert H. Jones.

By Messrs. Ward, Lock and Co:—

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BURTON (W. K.) Practical Guide to Photographic and Photo-Mechanical Printing. Post 8vo, pp. 370. Marion ... 4/

CUNLIFFE (R.) Helps to Technical Examination in the Cotton Manufacture. Comprising over One Hundred Questions and Answers, the former taken from the City and Guilds Examination Papers, the latter by R. Cunliffe. 12mo, sd., pp. 64. A. Heywood (Manchester). Simpkin ... 1/

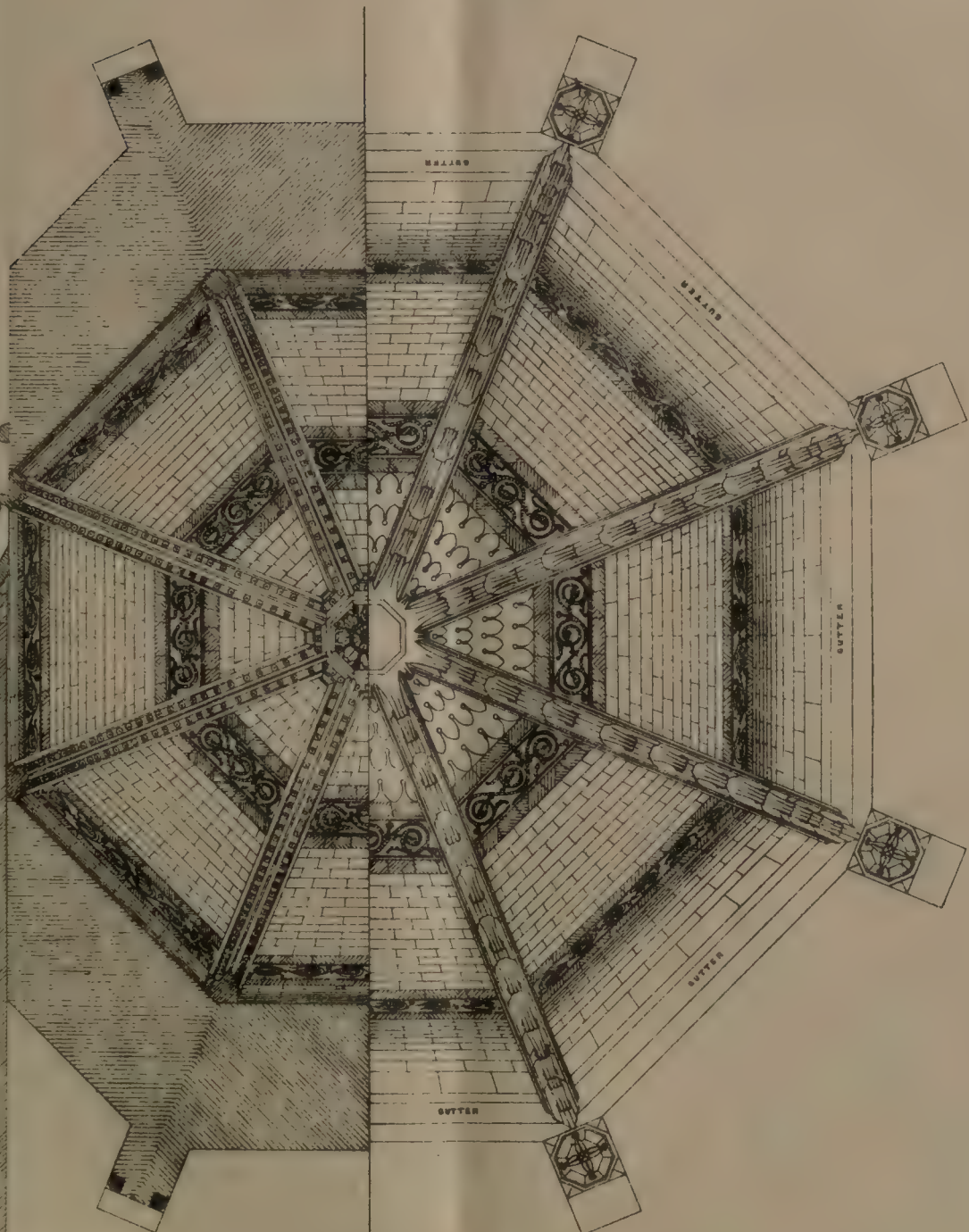
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INDIAN · PENINSULAR · RAILWAY · VICTORIA · TERMINUS ·

· AND · ADMINISTRATIVE · OFFICES · BOMBAY ·

· DETAILS · OF · PRINCIPAL · DOME ·



PLAN · OF · DOME · LOOKING · UPWARDS ·

· HALF · PLAN · OF · DOME · LOOKING · DOWNWARDS ·

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and the water are both at rest. If both cylinder and water be at rest, the pressure at any point D of the immersed convex surface should act along a line N D which if produced cuts the axis. Let H D G be a horizontal line touching the convex surface at D. Then if K D be some line in the angle N D G, and L D be some line in the angle N D H we have asserted that when cylinder and water are both at rest, the pressure R at D does not act along such a line as K D, or along such a line as L D. If this statement does not commend itself to the student as intrinsically reasonable he must consider it as proved solely by experiments.

Suppose that D C A is 90° and that we begin to pull or push the cylinder horizontally through the water. Let C move towards A, i.e., parallel to H G. Then all the pressures round a thin horizontal layer are altered. We suppose the cylinder so to move that its axis remains vertical, and that the line C D does not change its direction. In this case every point of the cylinder has the same velocity as has the centre C. In such a case the cylinder does not spin, it moves in one direction and has no rotation. Such a movement is as simple as can be imagined.

Now in this case the pressure at D will no longer be along N D. It will be along some line like K D. If the cylinder moved backwards, i.e., from C towards B, the pressure at D would be along some line like L D. When the cylinder moves from C towards A, there is at D a certain friction between the surface and the water. This friction on the cylinder is a force from D towards H. This new force, due entirely to the movement of the cylinder, will, when combined with the old normal pressure along N D, give, as we have stated, a force slantwise to the line H G. If the new friction force is small, the angle K D N will be small. As for the pressure at A it will not change its direction, but it will have a greater magnitude. This perhaps is clear. What is not perhaps so clear, but is equally true, is that the pressure at B, while retaining its direction, is diminished in intensity.

If this be doubted, let us imagine that the forward velocity given to C was very great. Then a vacuum would for a moment be created behind B, and therefore the pressure there would vanish entirely. When the cylinder moves with any finite velocity, all the pressures on the forward half of the cylinder D A O will be increased. They will also have their directions altered. The single exception to this alteration of direction is at the point A, or rather along that vertical line which passes through A and which lies in the surface of the cylinder. Instead of moving the cylinder one way we might imagine the cylinder at rest, and the water moving the other way. Such is the case of a vessel at anchor in a river or other mass of water which has a current.

Such a vessel as that indicated by *fig. 15* or *fig. 26* may be moved in any horizontal direction with equal facility. That is, a given force applied to the vessel northwards or eastwards will make the vessel move either north or east, respectively, with the same velocity. The vessel is supposed to be in an ocean or large lake. But if the vessel have its horizontal section narrow in one direction and elongated in a perpendicular direction, then its readiness to be moved by external forces is not the same in various directions.

fig. 27.

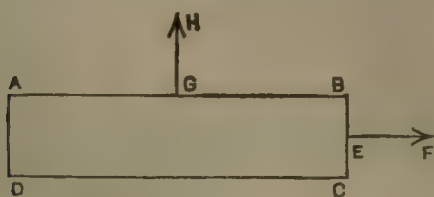
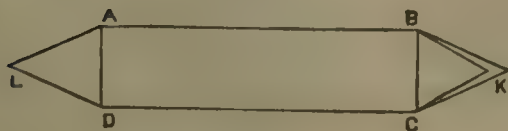


fig. 28.



Suppose as a simple case we have a wooden plank whose breadth is A D and length A B, its thickness is not shewn in the figure. Then we know by experiment, that such a body is more easily moved in the direction E F than in the direction G H. If A C be intended as a horizontal section of a vessel built to cross the seas, we might have A D, B C supplied with tapering ends as in *fig. 28*. If the vessel is intended to move in this direction from A towards B the use of the pointed termination B K C seems apparent. This cut-water, as we may call it, divides the water into two parts as a knife divides butter or any soft substance. It is perhaps not so obvious that the end A L D is also useful for a vessel which is only intended to move in the direction from A towards B. The use of the portion A L D is to enable the water on each side of the vessel more readily to fill up that vacuum behind the vessel which tends to be created as the vessel moves forwards. The tendency to the formation of a vacuum behind the vessel may be otherwise illustrated as follows.

fig. 29.

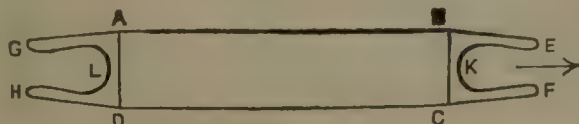


In *fig. 29* D E F G is a vessel represented by a vertical section. A C B is a body of water enclosed in a basin A C B. This water may be an ocean or a lake. The mass of the water is not shewn to scale compared with that of the vessel. The object of indicating the enclosing surface A C B of the water is to remind us, that no matter how large may be the expanse of water there is still some definite quantity of water in that volume A C B.

Now if we drive forwards the vessel D F in a strictly horizontal direction, we shall have the water piled or heaped up before E F. That is the level of the water just in front is raised. Therefore the level of the water at some other place must sink, otherwise the total mass of water in A C B would be increased. And it is clear that it is just behind the vessel, viz., just near D G that the level sinks. The increased column of water at E F must give an increased pressure backwards. The diminished column of water at D G must give a diminished pressure in the forward direction.

Suppose that when D F was at rest, there was over the forward part of the vessel a total backward pressure of 5,000lbs. Then there must have been over the remaining or backward part of the vessel a total forward pressure of the same amount. By the movement forwards of D F, the backward pressure may become—say—5,600lbs., and the forward pressure may sink to—say—4,800lbs. Here we avoid assuming that the increment of one pressure equals the decrement of the other pressure. On the whole, there is in one case a balance of 800lbs. resisting the forward movement of the vessel. The more the water is piled up in front of the vessel which is moved strictly horizontally, the more must the water sink behind the vessel. The object of the ship builder is to lessen both the forward accumulation of water and the backward loss of water, and we see that this accumulation and this loss are not unconnected.

fig. 30.



As a further illustration of this point we will indicate a very unsuitable shape for the fore and aft terminations of a ship. In *fig. 30* the original vessel A B C D shewn by a horizontal section, is furnished with a concave bow B E K F C and a concave stern A G L H D. If such a vessel is driven horizontally forwards the horns B E and C F help to imprison water in the space E K F. The column of water is great and will now rise to a greater height than if B C were left plane. This point may be illustrated if we move the hand rapidly through water, first with the palm flat, and secondly with the palm curved or hollowed. This piling up of the water in the space E K F must, as we know, be connected with a sinking of water behind the vessel or in the space G L H. Moreover, just as the horns B E, C F hinder the extra water at K from escaping, so likewise the horns A G, D H hinder the water at the sides of the vessel from flowing into the space G L H and so restoring the proper level.

Thus the presence of the figure A G L H D is a distinct evil added to that produced by the figures B E K F C. As the vessel moves forwards, the water in front has to divide into two portions. These portions have to pass the vessel and reunite behind the vessel. The more corners we give the water to turn, the more we impede the re-union of the waters behind the vessel. If we now look back to *fig. 27* we see that even the flat ends B C, A D impose on the water the necessity of turning corners. On the other hand, in the *fig. 28*, the corners are, so to say, partly rounded off, and not only is the passage of water facilitated from the front of the vessel, but, which is also important, the passage of water is facilitated to the rear of the vessel.

fig. 31.

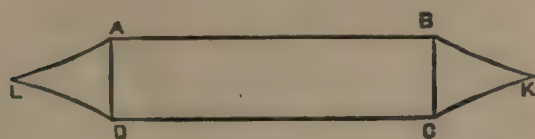
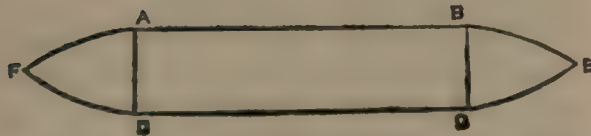


fig. 32.



The *fig. (30)* has helped us to understand a certain principle, we may now replace that figure by another which is less unlikely to be adopted in practice. Thus in *fig. 31* we have the vessel A B C D supplied with pointed ends, and each end is made of two parts which are concave to the waters. Now compare this figure with that of *fig. 32*, where the halves B E, C E, are convex to the water. Each figure seems possible for the section of a ship. The ends K, L of *fig. 31* seem sharper than the ends E, F of *fig. 32*, and this at first sight may seem an advantage in favor of *fig. 31*. But in *fig. 31* the water has a tendency to lodge in the slightly hollowed spaces B K, C K. Thus, even if the ship-builder had no object in building a ship except to make it move as fast as possible directly forward, he might still be likely to prefer the convex bow to the concave. But, as a matter of fact, he has at least three other reasons for preferring the convex shape.

* We regret to record the death of Mr. Robert Hadfield, of Sheffield, on the 21st instant. Mr. Hadfield was the founder and principal partner of the Hadfield Steel Foundry Company, Sheffield. He erected the present extensive works in Newhall Road, and there developed an extensive business in steel castings, and invented processes for the rapid making of steel, which embodied some of the best features of the Bessemer, the Siemens-Martin, and similar processes. His firm have attained considerable celebrity as makers of steel castings for a great variety of purposes.

ON THE CONSTRUCTION OF SEWERS IN MADRAS.

BY HORMUSJI NOWROJI, B.C.E.,

Assistant Engineer, Madras Drainage Works.

III.

Cost of Excavation.—The rate paid for excavation was 2 annas per cubic yard for the first 6 feet in depth and 6 annas per cubic yard below 6 feet. But in narrow and busy streets, the excavated soil could not be heaped up by the sides of the trench. It had to be carted away to long distances and brought back for refilling. Under these difficulties, the rates paid were 3 annas and 9 annas per cubic yard. These rates include the labor for timbering also.

Arrangements for Pumping.—Heavy pumping was necessary during the construction of the deeper portions of the sewer on account of the sandy nature of the soil—an extremely porous and water-bearing strata. Where pumping was necessary, it was kept on night and day without intermission as long as the sewer was under daily progress. Water was pumped out of wells sunk on the line of the sewers. The wells were made three feet square inside and were sunk until the curb was 6 feet below the sill of the sewer. Two feet thickness of concrete was laid at the bottom, making the bottom water-tight. The trench was connected with the well by drain pipes laid below the concrete bed of the drain. The sewer was built over this, and the line of drain pipes was lengthened out as the work progressed, so that the trench was always kept free of water. Earthenware pipes of local manufacture were used and jointed with clay. Where the amount of water necessitated the use of the pumps or pulsometers, the size of the pipes was 7 inches in diameter. But where piccottahs were sufficient to do the work, 4-inch diameter pipes were used.

The fall of the sewer being only $3\frac{1}{2}$ feet per mile, it was necessary to give a greater fall to the drain pipes in order to secure the requisite discharge and prevent deposit of sand inside. It was however difficult to keep the pipes from being choked with sand for long lengths. It was incumbent to shift the pump to another well higher up at distances of 300 or 600 feet, according to necessity. A fresh length of drain pipes commenced from each new well.

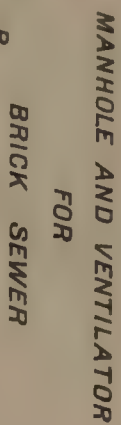
Pumping Machinery.—During the construction of sewer No. 3, which was the first sewer taken in hand, 8-inch centrifugal pumps were employed to pump out water. From the extremely loose and sandy nature of the soil, the water to be pumped up was very much mixed up with sand which had to be passed through the pumps. The pumps used to get clogged and stoppages were frequent.

The Advantages of Pulsometers.—In the construction of sewers No. 1 and No. 2, pulsometers were substituted for centrifugal pumps with extremely satisfactory results. The advantages of the pulsometer with special reference to sewer work may be summed up as follows:—

(1.) Its ability to raise sand. Pulsometers, unlike centrifugal pumps, are capable of draining up, not only water, but any sand or earthy matter suspended in the water without injury.

(2.) Simplicity. The arrangements of the apparatus are extremely simple without the intervention of any of the component parts of a pumping engine, which require the careful attention of the driver, and which make break-downs more frequent and repairs more difficult. Such break-downs, not only delay the work, but are actually injurious to the portion in immediate progress, as the work is swamped.

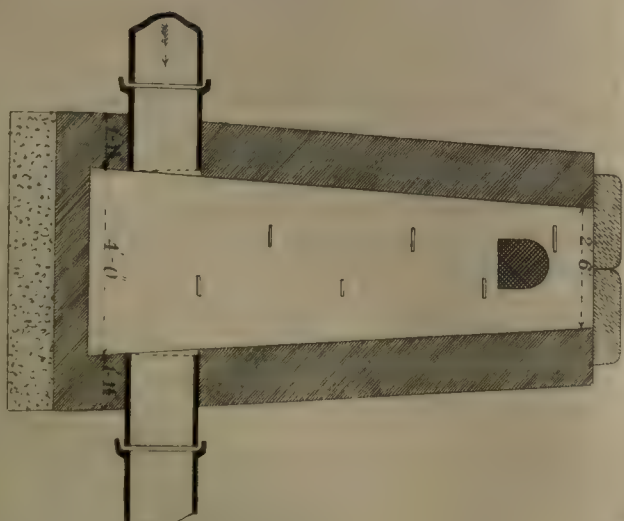
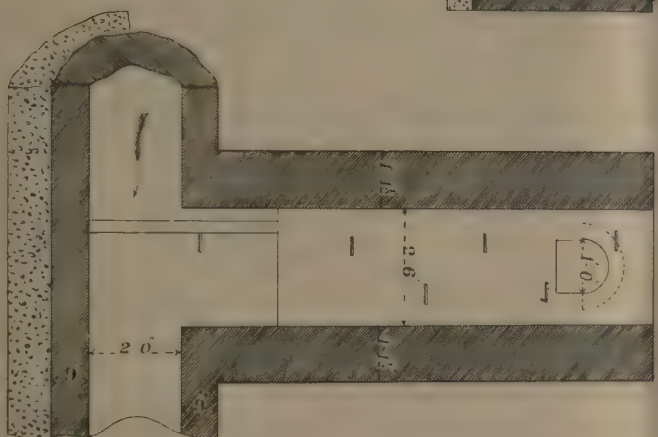
(3.) The pulsometer can be slung from a beam by chains and pulleys which admit of the pulsometer being raised or lowered as necessary. Centrifugal pumps were made to rest on the walls of the wells which were built up to the required height. But the wells were found to sink and crack at their connections with the sewers, owing to the weight and vibrations of the pumps.



MANHOLE FOR PIPE SEWER



Section on C.D.



SCALE



(4.) The boilers can be kept further apart from the pulsometers than from centrifugal pumps. In the latter case excessive length of belting interferes with the efficient working of the pumps. This is a matter of no small consideration, as a boiler placed close to a deep excavation may endanger the excavation and be itself in an unsafe position.

Two sizes of pulsometers were used, particulars about which will be gathered from the subjoined statement:—

No.	Size of suction pipe.	Size of discharge pipe.	Horse-power of Boiler.	Cost of Pulsometer.	Gallons per hour.	Cost per day.
5	4"	3"	10	Rs. 700	8,000	18
8	6"	5"	16	1,500	22,000	24

The number of gallons shewn on the table represents the actual gauged discharge of a total lift of 15 feet under full pressure of steam. But it was not necessary to work the pulsometer under full pressure of steam, unless during rains or on resuming pumping after a stoppage. The usual quantity lifted representing the actual percolation through the soil in the deepest portion of the trench for a length of about 100 feet was considerably below the above quantity.

Cost of Pumping.—The following are the details of working the No. 8 pulsometer for a full day, i.e., 24 hours:—

	Rs.	As.	P.
1 Driver	1	0	0
1 Assistant	0	8	0
1 Driver to keep the foot valve clean	0	8	0
4 Water coolies	1	0	0
2 Tons of dry casurina wood	20	0	0
Lights, oil, waste and contingencies	1	0	0
Total Rs.	24	0	0

Foundation Concrete.—The foundation of the sewer consists of 6 inches depth of soorkee concrete laid to the full width of the bottom of the trench from plank to plank. Concrete is also laid at the haunches to the level of the centre of the sewer. The proportions of the concrete were—

6 of gravel,
2 of soorkee powder,
1 of slaked chunam.

The gravel used was such as would pass through a ring one inch in diameter. All gravel passing through a $\frac{1}{4}$ inch mesh was rejected.

Soorkee was made out of brick bats and was sufficiently fine to pass through a sieve with 36 meshes to the square inch.

Foundation in Bad Soil.—The extremely bad soil at the level of the bottom of the sewer in some places in Popham's Broadway has already been mentioned. This was specially so at the north end of the Broadway, where a crowbar used to sink by its own weight vertically through a depth of four or five feet into the soil below the level of the sewer. The method devised to get over this difficulty was to work the sewer in sections of 10 feet. Granite and laterite boulders and debris from dismantled masonry was thrown into the trench and the slush was removed by buckets as it rose above the level of the sewer. By this means the slush in the trench was replaced to a large extent by more solid substances. Over this base cement concrete varying in depth from a foot to a foot and a half was laid. The bed thus formed for the construction of the sewer presented all the solidity and firmness that could be desired under the circumstances. The usual method of supporting the sewer

on piles under similar circumstances was not resorted to for fear that wood might perish in such a soil.

Cement concrete used is composed of—

6 of gravel,
3 of sand,
1 of cement.

(To be continued.)

NOTES ON THE HEBBAL WATER SCHEME.

THE accompanying sketch map shews that the catchment basin of the Hebbal tank (and the tank above it) is nearly 14 square miles, consisting of steep hilly ground from which the rainfall apparently runs off very freely, all the drainages being deeply cut, evidently by large volumes of water, there are springs in these which are now running slowly, and it might be worth while to bore these with Norton's tubes with a view to compensate the Hebbal reservoir during the dry season for losses by evaporation, which during this period of the year, when hot dry winds prevail, must be considerable, though probably not so great as is imagined.

2. I believe it is quite safe to assume that the Hebbal reservoir has a catchment basin of at least 10 square miles, without interfering with any other claims. The accompanying statements Nos. I. and II. shew that the mean annual rainfall is 36 inches in this province. No. I. is taken from General Sankey's Report and No. II. from the records of the Bangalore Meteorological Observatory. There is an interval of six years from 1862—67, the records of which I have not been able to obtain but the information given for a long period of 41 years clearly shews the necessity for storing water on a large scale, so as to tide over at least two years. In the first period of 21 years, though no actual famine is recorded, there were two consecutive years, viz., 1854—55 in which the rainfall was far below the mean annual fall. These two years were preceded and followed as usual by excessively heavy rains. The maximum fall in this period of 21 years was 55.1 inches in 1852, and the minimum 26.6 inches in 1859: for these years, I have no record of the greatest fall in 24 hours. In the second period occurred the famine years of 1875—76, when the rainfall was so little as 17.29 inches in one season—here again we have the phenomenon of two consecutive dry seasons, and in 1884 the rainfall was again exceedingly small; so then, it is quite apparent that for a town supply with so large a population as Bangalore, a population which is likely to increase, the storage should be for at least three years.

I proposed before to allow only $6\frac{1}{4}$ gallons per head per diem for a population of 150,000 and shewed that about 3 million cubic yards of water would suffice for a year's supply inclusive of losses by evaporation, &c. I would now recommend that the supply should be $12\frac{1}{4}$ gallons per head. The storage required for one year then will be about 5 million cubic yards, or 15 million cubic yards for three years for the Town supply. I am not concerned now with the water required for irrigation under this reservoir, which from its present exceedingly small capacity, and from the records in seasons of drought, renders it evident that the ryots are liable to lose all their crops, though it is a matter of no difficulty in such a basin to secure the interests of the Government and the ryots from all such losses by properly designed hydraulic works. If the Hebbal reservoir had been enlarged so as to contain 30 million cubic yards of water (as much probably as ran off the catchment basin in 1874, the year before the famine) and the consumption for town supply and irrigation, was 16 million cubic yards in 1875—76 there would have been a balance of 14 million cubic yards. When the heavy rainfall of 1877 occurred and drained off in all probability not less than 15 million cubic yards, the store could have been made up to 29 million cubic yards. Again, allowing the consumption for one season to have been 8 million cubic yards and the balance remaining to be 21 million cubic yards—the water run in for 1878, not less probably than $15\frac{1}{2}$ millions cubic yards,

the reservoir would have had to surplus some $6\frac{1}{2}$ million cubic yards: surpluses would also have occurred in 1879 and 1880. As the reservoir would have been left quite full, the dry season of 1881 would have been easily got over, with a large balance of perhaps 22 millions to credit, and in 1882-83 the reservoir must have again discharged surplus water. I trust I have now made it apparent how very important it is to have reservoirs in such a province as this of the largest capacity, both for town supply and irrigation purposes. Water, like capital, if properly worked, is sure to accumulate with profit. If dealt with as it has been for so many centuries in India, but for the merciful bounty of Providence, the whole population must have died out. The hydrological conditions of this province (statement No. III) in a country like India, are so remarkably good that it seems a marvel so little advantage has been taken of them. The mean annual rainfall is upwards of 36 inches, and of this, over 96 per cent. falls during a period of 7 months, from May to November, the dry season lasting for only 5 months or 151 days, not longer than in parts of England, and yet a town like Bangalore has been unable to get a proper water-supply. There cannot be a shadow of a doubt that the means are abundant, and as I have now pointed out how these can be easily made available, it will rest with the Municipality to see that they are properly utilized.

It has been brought to my notice, that in the past year as much as 9 inches of rain fell in 24 hours at one of the stations of the Southern Maharatta Railway. This fall appears to be the largest on record. In enlarging the reservoir the surplus weirs must be made large enough to dispose of such floods with a moderate head. Mr. Binnie has recorded at the Nagpur water-works, that upwards of 195,000 cubic feet per minute ran into their reservoir from a rainfall of 2.70 inches lasting 2 hours and 50 minutes. This yield was upwards of 98 per cent. of the fall, and occurred on the 16th September 1872, at the close of a heavy monsoon season. If we take the probable rate of discharge required to be provided for at 200,000 cubic feet per minute, a waste weir of 300 feet in length will discharge this with a head of less than 2.2 feet: the top of the bund should then be at least $7\frac{1}{2}$ feet above full tank level to make the work as safe as possible.

I have ascertained that water is now costing upwards of Rs. 2 per 1,000 gallons in Bangalore. At the Ulsoor water-works it appears to be supplied to the barracks by the two engines for about 6 annas per 1,000 gallons. With one powerful engine at Hebbal, and by pumping the water up to the Muntapum Hill, where it can be distributed to all parts of the town and cantonment by gravitation, I see no reason why the place should not be well supplied with water for about 4 annas for 1,000 gallons, that is, 2 annas for actual consumption and 2 annas per 1,000 gallons to form a reserve fund to pay off the cost of the works if made by loan. The quantity of water to be delivered in a year is about 850 millions of gallons, and if the cost of maintenance, interest, depreciation, &c., should amount to Rs. 75,000 per annum, the cost of 1,000 gallons would be only $1\frac{1}{2}$ anna. To illustrate that a 100 H.-P. engine is quite able to do the work, I beg to add the following extract of the performances of such an engine from Molesworth:—"Mr. Wicksted, the Engineer to the East London Water-Works Company, records, that a single pumping engine by Harvey & Co., upon the expansive principle, in 1837, working 24 hours per diem, 7 days per week, mean power $95\frac{1}{2}$ horses (average of four years' working) delivered 4,107,816 gallons, raised 110 feet per diem at a cost of 15*d.* for 1,000 gallons, raised 100 feet or about 2 pie per 1,000 gallons." Engines have been much improved since the above was recorded, and as it is proposed to have for Bangalore less than half the above quantity, a 100 H.-P. engine will do all that is necessary and provide a large reserve power.

On the sketch map which accompanies these "Notes," I have marked the contour level of the Hebbal tank as it exists, containing perhaps $1\frac{1}{2}$ million cubic yards of water, and irrigating about 165 acres of land. Its bund is crook-

ed, and it is difficult to fit another to it on a good alignment. The general idea of raising the bund a mean height of 24 feet is shown in the accompanying section. I estimate approximately the cost of this bund, including stone facing, tamping, waste weirs, &c., at Rs. 60,000.

In the new bund I would have no sluices, the water required for irrigating the land below can be supplied, if required, by a syphon or by the engine.

I am unable to furnish the Board with detailed plans, estimates &c., for I have no establishment allowed me whatever, and I have had to do the work with such assistance as I could pick up.

The other contours at 15 and 30 feet above existing full tank level, shew the capacity of the reservoir when improved, and the extent of land to be submerged for which compensation will have to be provided.

On the sketch map I have marked the two lines of main which can be adopted. By our corrected level I find Hebbal tank is 2,923 feet above mean sea level; if it is raised 30 feet and the Engine House placed about 7 feet above this, the working level will be 2,960, and if the water is forced up 100 feet, it will be delivered at the junction of St. John's Hill Road with the Hebbal Road at a level of 3,060 feet, which is quite high enough to command all parts of Bangalore, except one small point. The length of main required for this is about 13,000 feet, and it will have to be carried across some rough ground and deep valleys. The other line goes direct to the Muntapum Hill and the main required is only 11,000 feet in length, but the water will have to be forced up to a height of 153 feet. If this line be adopted, it would be advisable to cut off a point of this Hill, which is a mere peak, say for 33 feet, making a general distributing reservoir there and supplying every part of the station and town by gravitation, as the water then will be at a level of 3,080, if forced up 120 feet. This is, I believe, the better project to adopt with such an abundant supply of water. It would also make a very large extent of land about the Muntapum Hill available for building purposes.

In preparing statements Nos. I. and II., I have used Molesworth's data for Mysore, *viz.*, rain-fall of 30 inches and a run-off of .25 or .75 inches. In those years in which this fall was in excess of 30 inches, I have added the excess to the above run-off; and in those seasons in which the rain-fall was less than 30 inches, I have deducted the deficiencies. This gives as near an approximation as it is perhaps possible to get, and agrees very well with Mr. Binnie's records for the Nagpur water-works. In those seasons in which the rain-fall was about 23 inches and under, I have put down the discharges as "Nil," for except the rain which actually falls on the water-spread of a reservoir it is impossible to rely on any discharge for storage purposes. In the years of excessive heavy rains of 45 inches and upwards, these data give discharges up to .5 and .6 of the fall, and these agree very well with the records of the Vehar water-works and other places in India.

I have had no opportunity to make the contour for the channel from the north, but I believe this is quite feasible by a low water-shed immediately above the village of Koodigihully, and this would add the drainage of 6 or 7 square miles to the Hebbal basin. This work is not required at present, but I can easily have it tested and placed on record. The Hebbal basin can also be supplemented from the Arkavutty river by pumping, if more water is required at any time. But all the records shew that the water-supply of this catchment area, if properly stored, will be abundant for double the existing population of Bangalore. From this site the water can be pumped to the highest point of this station with the least lift and length of main, so that in every respect it possesses every possible advantage. It is, I fear, quite impossible to do anything with Sankey's reservoir beyond supplying it from Hebbal and allowing the water to be used for the pettah. The Agram tank project, besides being more than 50 feet below the Hebbal tank as it now exists and 89 feet below the proposed raising, is situated

3 miles south-east of the Cavalry and Artillery barracks the furthest extremity of Bangalore, and a main from this to supply the whole station and pettah would have to be some seven miles in length as compared with the two miles from Hebbal. This tank has some 26 tanks in its catchment basin of only 32½ square miles above it, and into this basin is discharged all the sewage of the pettah, the Arab, Pioneer, and Commissariat bullock lines, as well as that of the Cavalry and Artillery horse lines, and there are some half dozen burial-grounds within its limits. Except its waters, then, are thoroughly distilled, they can hardly be made fit for drinking purposes, and the compensation asked for this site is almost prohibitive, if its other disadvantages were not so great, as regards lift to get any proper command and the distance the water must be conveyed before it can be of any use.

My approximate estimate for the project to the top of the Muntapum Hill, then, is as follows :—

	Rs.
1. Improving and raising and extending Hebbal tank bund with waste weir 300 feet in length, syphon, &c., complete ...	60,000
2. Compensation ...	40,000
3. Engine and pumps ...	50,000
4. Main ...	50,000
5. Engine house and chimney ...	12,000
5. Quarters for establishment ...	8,000
6. Cutting the Muntapam Hill ...	10,000
7. Distributing reservoir with filter bed, &c ...	40,000
8. Compound wall, roof for the reservoir and bridge on Hebbal Road and sundries, &c. ...	80,000
	Rs. 3,00,000

or 3 lakhs of rupees for bringing the water to the highest point in Bangalore from the shortest distance, and with the least lift, the proposed reservoir having at the same time the largest and cleanest catchment drainage area available in its vicinity. The further distribution of the water to all parts of the town and station can be considered and estimated for whilst the works at Hebbal for storing and pumping the water are being constructed. The water can then be easily supplied by gravitation alone to every part of Bangalore under 2 annas per 1,000 gallons, which would be considered, in any part of the world, a most moderate rate.

Having received no assistance whatever from the Engineer to the Municipality, I have been obliged to do the field work with the instruments kindly lent me by Mr. Molloy of the Maharatta Railway, and Mr. J. Cook of the Mysore College. To these gentlemen I am deeply indebted for their generous assistance, otherwise I could not possibly have even furnished the information now prepared. My thanks are also due to Mr. T. T. Leonard for valuable aid.

J. F. FISCHER, General,

BANGALORE, February 24 1888. Royal Engineers.

REMOVAL OF WRECKS.

We left Calcutta on 25th February last by the I. G. S. N. Co.'s S. S. *Rajmehal* for the Sunderbuns and took with us a diver and diving gear, together with boats, men, and explosives for destroying the wrecks of the two flats *Borpetta* and *Byrub*, as well as two snags endangering the navigation of one of the rivers. We reached the site of the wreck of the *Borpetta* on the evening of 28th February last, and commenced operations the following day, and completed the destruction of the wreck on the evening of the 4th March. The diver after exploring the blasted wreck reported that all was down flat, and the minimum depth of water at low water was 6 feet. On the 5th March we blasted away two large snags in the Attarabanka River. On the 6th the I. G. S. N. Co.'s S. S. *Mirzapore*, with two flats, came along and took us in tow; the flat on Port side of steamer passed over the site of wreck at low water. We reached the site of the wreck of the *Byrub* on the night of the 7th got to work next day, and by

noon on the 13th completed the destruction of the wreck. It was blasted down on to the bed of the river, where all the iron-work, except a few pieces salvaged by the villagers, lies at low water. There is 3 feet of water over the battered wreck nearest the bank, and on the remainder 12 to 15 feet of water. It will, I consider, be quite safe for steamers and flats to go over from high water to rather less than half tide, but it will not be safe for flats to scrape the bank at low water, as the iron-plating of the wreck is lying in the mud, and would almost be certain to scrape a hole through them. There is 5 feet more in depth of navigable water over the highest edge of the wreck than was before it was blasted down. On the 15th the I. G. S. N. Co.'s *Princess Alice* came along and took us in tow; and we arrived back at Calcutta at 6-30 P.M. on Sunday the 18th March.

Explosives expended in destroying the wreck of the River Steam Navigation Co.'s Flat "Borpetta" in the River Atturabanka, Sunderbuns, of Bengal.

1888.	Description of Charges.	Number of Shots.	Dynamite lbs.	Gelatine Dynamite lbs.
Feb. 29.	No. 1 Shot. Consisting of four hoses, each 18 feet long x 2½ inches diameter, tied together (ends overlapping), making a charge 70 feet long, laid on edge of deck from the bow, aft, on Port side, fired at 5 P.M. Result, all the beams under it broken off and side blown down on to river bed ...	1	203	...
March 1.	No. 2 Shot. Consisting of 4 lengths of canvas hose, each 18 feet long x 2½ inches diameter, making up a shot 70 feet long, laid on edge of deck aft and in continuation of No. 1 shot on Port side, fired at high water 2-30 P.M. Result, broke off all the beams under it, and blew side down on river bed...	1	100	64
" 2.	No. 3 Shot. Consisting of a canvas hose, 36 feet long, 2½" diameter (20' + 18' tied together), laid on edge of deck aft, and in continuation of No. 2 shot Port side, and taking in part of stern, fired at low water about 10 A.M. Result, broke off all beams under it and blew side down on river bed ...	1	50	42
" 3.	No. 4 Shot. Consisting of three 18 feet lengths of canvas hose, and one 13 feet length tied together, making a charge 67 feet long, laid on edge of deck on starboard side, starting from the stern and trailed forward, fired about 4 P.M. Result, broke off all beams under it and blew side down on river bed, also gave a considerable shock to the diver boat, and the dinghi it was fired from ...	1	70	115
" 4.	No. 5 Shot. Consisting of two lengths of canvas hose, each 13 feet and one 18 feet hose, the whole made into a 42 feet length, laid on edge of deck, starboard side, trailed forward in continuation of No. 4 shot, fired at low water 10-30 A.M. Result, broke off the beams and blew the side out flat ...	1	42	75
" 5.	No. 6 Shot. Consisting of four 18 feet lengths of canvas hose tied together, making a charge about 70 feet long, laid on edge of deck on Starboard side, trailed forward, and in continuation of No. 5 shot, fired at high water 4 P.M. Result, the beams under it were broken off and sides laid out flat ...	1	33	140
" 6.	No. 7 Shot. Consisting of 51 feet of canvas hose in one length, laid on edge of deck starboard side, trailing forward and in continuation of No. 6 shot, extending to the bows, fired at low water about 10-30 A.M. Result, broke off remainder of beams, and blew down the side, leaving wreck a mass of chaotic ruins ...	1	38	64
" 7.	No. 8 Shot. A small local charge placed against a wooden stanchion post sticking out near the bows. Result, blew it to pieces ...	1	2	...
	Total ...	8	498	500

(To be continued.)

NOTES FROM HOME.

(From our own Correspondent.)

A VERY valuable report on the Destruction of Town Refuse by Mr. Thomas Codrington, one of the Engineering Inspectors of the Local Government Board, has been issued recently. This work is the result of personal visits to all the towns in Great Britain where works for the purpose have been established. The composition of refuse is given, and the difficulties met with in the disposal of certain descriptions of the material. Illustrations are given of destructors in use at Manchester, Birmingham and Glasgow, also Fryer's Destructor. Detail descriptions and cost of working are given of destructors at Leeds, Bradford, Bolton, Bury, Preston, Salford, Newcastle, Hull, Derby, Nottingham, Blackburn, Heckmondwike, Warrington, City of London, Whitechapel, Ealing, Southampton, Buxton, Bournemouth, and Winchester. Then follows descriptions of other furnaces, Healey's, the Beehive, the Nelson, and the Carbonizer. Valuable particulars of experiments and observations are given on Temperatures; of the volume of air entering the furnaces; of the proportion of moisture in refuse; of analyses of escaping gases, and of the aqueous vapours. The whole report closing with general conclusions. This report and the paper recently read and published by Mr. Jones of Ealing, the originator and patentee of the Fume Cremator, form together a complete treatise on the subject of the disposal of Town Refuse.

In the discussion following Mr. May's paper referred to in my last letter, a question was asked whether the author had found by observation or experiment that the sewer air invariably passed upwards from below rather than downwards from above. This point was discussed at some length, and reference was made to observations and experiments made at Hampstead and Wimbledon by Mr. Lowe and Mr. Crimp respectively. In the former locality, it was stated to be found that the flow of sewer air was prevailing in an upward direction, while at Wimbledon the prevailing direction of the flow was downwards. The general conclusions seemed to be that the direction of the flow of the air in sewers was largely influenced by the direction of the wind, and that it was also largely influenced by the contour of the ground. The general tendency in hilly localities being for the sewer air to rise. The usefulness of sewer flaps in "districting" the area of sewer gas accumulations was admitted, but it was confessed that this question of the motion of sewer gas and the ventilation of sewers is one in which further observations and careful experiments are necessary.

The *Builder* of this week gives an illustrated description of a new passenger lift, whose novelty lies in the arrangement of a patent safety catch. As direct-acting ram lifts cannot be insisted upon universally, there are certain practical considerations, such as the increasing height of buildings, and the greater cheapness of the suspended types which enforce the adoption of the latter. And this being admitted it would seem that the "Reliance," which is the name given to the particular lift described, is a very decided step in advance. One of the principal virtues of this arrangement is that any additional stretching of either one of the two ropes will throw the gripping cams into contact.

The Institution of Civil Engineers has issued to its members a statement of the Council against the second reading of the Architects and Engineers' Registration Bill, which requires persons in these professions to be registered, and establishes a general Council to have charge of their registration and control over their examination. The Institution urges that the process of election to its membership is already sufficient to insure the competency of the practitioner. The Bill proposes to substitute for the present order of things a system of examination and registration involving at every step payment of certain fees, and coupled with large penalties as against unregistered practitioners. The effect of this would be to render it impossible for any person not having received an expensive education to become in future a Civil Engineer. It is represented that this would be highly detrimental to the interests of the public at large, for it is a well-known fact that many of the most distinguished British Engineers have attained their position by the force of their natural genius, unaided by the advantages of pecuniary means affording an expensive education. The case of George Stephenson is instanced as a striking illustration of this fact. The Institution of Mechanical Engineers also petition against the Bill, as do also the Royal Institute of British Architects, the

Surveyors' Institution, and the Association of Municipal Engineers. On the other hand, petitions in favor of the measure are being sent in from all parts of the country, principally from medical officers of health and the general public.

Her Majesty's ship *Nile* was recently launched from Pembroke Dockyard. This iron-clad is the heaviest ship yet constructed, she is of the turret and barrette classes, and is possessed of all the best fighting and sea-going qualities of each. The *Nile* is 345 feet long between perpendiculars, and 73 feet broad; her displacement tonnage is 11,940 tons, her armament is exceptionally heavy and powerful. The vessel is fitted with twin screws, and is expected to travel 16½ knots. The boilers are six in number.

Next week another first-class battleship will be added to the Royal Navy, by the delivery from the contractors, Sir W. Armstrong and Co., of Newcastle, of the *Victoria*, one of the most formidable turret ships ever built in this country.

This ship has a displacement of 10,740 tons. Her engines are of 12,000 horse-power, and are capable of propelling her at a speed of 17 knots. She will be armed with two 110-ton guns, besides other heavy and powerful armaments. The total cost of the ship will be over £800,000.

An important addition was also made a few days back to the Royal Navy by the completion for sea of the new composite sloop *Buzzard*, which is the first of a new class of fast heavily armed sloops, designed by Mr. White, Director of Naval Construction.

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

As the great Poughkeepsie Bridge approaches completion, it may be of interest to note the quantity of material and size of some of the component parts. It is the largest double track bridge in the United States, and with the single exception of the bridge now in progress of construction over the Firth of Forth in Scotland, the largest in the world. The amount of material used in the foundations of the piers is soon forgotten, as they are necessarily out of sight under water. These foundations, four in number and 500 feet apart, are caissons 60 feet wide and 100 feet long, built of 12-inch timbers filled with concrete, so that they are one solid mass for 110 feet upwards from the solid gravel which underlies the mud and silt forming the river bottom. Upon this lies a grillage, a solid platform of 12-inch timbers 50 feet wide, 90 feet long and 15 feet thick. The masonry is built upon this grillage and extends up through the water to a height of 30 feet above high water, the top being covered with a sloping roof of flagstones. Each of these foundations and piers contains 3,000,000 feet of lumber, 7,000 cubic yards of concrete, and 900 cubic yards of masonry. From the masonry, steel towers rise 100 feet upwards to the lower chord of the trusses. These towers weigh 200 tons each. The truss spans are 525 feet long each, and the three cantilever spans 548 feet long, weighing 1,600 tons each, and the two half spans or arms 201 feet long weigh 400 tons each.

The erection of these spans and cantilevers was done as follows: False works were built under the truss spans, upon piles 130 feet long, driven down into the bottom of the river, over 500 piles being required to each span. These false works were carried up 130 feet above high water, and upon them was laid a track upon which a huge traveller, the largest ever built in this country, was placed; then a hoisting engine was raised to the floor of the false works which lifted the steel work into place. When the truss was completed, the false works were removed, and the piles pulled out, leaving the river unobstructed. The cantilever spans are built out piece by piece over the river without false works or other support from below, the traveller running out upon the portions just erected until the opposite arms are joined together.

One truss span remains to be erected. All the steel work is either ready at the landing below Poughkeepsie or at the shops at Buffalo, N.J., or Athens, Pa.

During this winter, the erection of the viaducts will be completed. The foundations are almost entirely ready. They will contain 6,000 or 7,000 tons of iron and steel.

On the west side of the river a viaduct over 1,000 feet long stretches out to the hills, where a large number of laborers are at work, levelling the way for the railroad approach two miles long, with steam drills, dynamite, etc. These approaches will also be double-tracked, like the bridge, with 70lb. steel rails.

On the east side the viaduct leads off through the northern part of the city of Poughkeepsie, 2,700, feet, passing over the streets and houses until it reaches ground. From that point eastward, a railroad approach runs north to connect with the railroads running from Poughkeepsie north-easterly to Connecticut and Massachusetts, destined to become widely known as the great coal route to New England, and the all rail passenger route to Southern and Western New York, Pennsylvania, and the south and south-west and west. Running at the ordinary rate of speed of such trains passengers can be carried from Boston to Washington in two hours less time than by any present route. The times require unbroken rail transportation, and the Poughkeepsie Bridge will fill a want which has been felt for many years in Pennsylvania and New England, and will provide a means for the steady and regular carriage of fuel to the factories and residents of the New England States throughout the year. The enormous cost has in the past deterred the railroads from separately attempting the construction of bridges across the Hudson River, and as piers are very important factors in stability of railroad bridges, no other bridge than that at Poughkeepsie can be now constructed without special legislation. The Engineers of New York State and of the U. S. War Department have unanimously approved of the location of this bridge on account of the even width and great depth of the river at that point, and for several miles north and south. The largest tows and steamers have been passing between the piers of this bridge without difficulty. This bridge will, when completed, be the largest railroad cantilever bridge in this country.

At the recent Annual Meeting of the American Society of Civil Engineers, Lieutenant Charles O. Rogers, U.S.N., read a paper entitled, "The Panama Canal in 1887." Lieutenant Rogers was sent to Panama about a year ago (March 1887) to make a report for our Government, and made a two weeks' tour of inspection along the entire route of the canal with M. de Lesseps' Engineer. He described minutely the sections and divisions into which the work was divided, and pointed out that the Chagres River, which crosses the canal twenty-seven times, and the Rio Grande, which crosses thirteen times, should be properly deflected if the project should ever succeed. The great drawback to the proper completion of the work is the scarcity of labor. About 11,000 laborers are employed, their pay being \$1.50 in Columbian silver, equal to ninety cents of American money. The natives of Jamaica were found to be of little use on account of their shiftless habits, and the company has imported negroes from the Congo and Chinese from the southern portion of the Celestial Empire, who give greater satisfaction.

Many of the laborers were forced out of the country, owing to exorbitant rates, unhealthy climate, malaria and yellow fever striking down an average of over 10 per cent., and necessitating the building of two large hospitals and a number of smaller ones, while thirty-seven physicians were kept constantly at work attending to the wants of the sick. Another occurrence which retards the work are the annual floods, which force excavated earth back into the trenches, and in many instances taking five and six weeks to repair the damage. Two-thirds of the work of excavation have yet to be performed, and to do this more men must be employed, more barracks must be built to accommodate them, and more hospitals to provide for them.

Lieutenant Rogers says: "For the \$240,000,000 originally required, the canal cannot possibly be built. At least \$375,000,000 will be required, and the officers of the canal company have at last admitted the truth of that fact. It can never be built in the time stated, but if pushed with vigor it may be open for navigation in six or seven years. The features of the scheme present no insurmountable obstacle. The company has both money and brains to carry it out, so in spite of opinions to the contrary, I am of the belief that the opening of the Panama Canal is really but a question of time."

A stupendous railroad scheme is under consideration by certain capitalists and railway magnates in Chicago, St. Paul and Minneapolis. It is a railway from the twin cities (St. Paul and Minneapolis) via Bismark, British Columbia, and Alaska, to Pekin, China, and Irkoutsk, in the Russian empire. The Minneapolis and Pacific, the Aberdeen, Bismark and North-Western, and the Canadian Pacific will form the line to Victoria in British Columbia, thence the road will

be built to Cape Prince of Wales, on Behring Straits, a distance of about 1,100 miles. This body of water, which separates the American Continent from Asia, is only 35 miles wide, and midway is dotted with islands. The water is twenty or twenty-five fathoms deep, and, will probably be bridged. On the opposite side in Asia is East Cape, whence a road will be constructed to Pekin, China and Irkoutsk, Russia, and other points in the Chinese and Russian empires. A road is already being constructed by the Russian Government to Irkoutsk and it is expected that this will be extended to form a juncture with the line from East Cape to Pekin, about 1,600 miles from the Straits. The distance between Cape Prince of Wales and Pekin is but little over 1,600 miles, making the whole route from St. Paul and Minneapolis to Pekin 5,169 miles.

This certainly is a stupendous scheme! Your correspondent has been informed as to this, by a prominent Engineer who was recently in New York with several other Engineers and contractors studying the matter. He said: "The first trains are expected to run through in ten days' time; but, when the inevitable limited is put on, the passenger who leaves St. Paul on Monday will take his breakfast in Pekin on Saturday morning, and his supper on Sunday evening in Hong-Kong."

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, April 14, 1888.

Lower Burma.

Mr. J. M. Joseph, Sub-Overseer, 3rd grade, Thayetmyo Division, has passed the Colloquial test in the Burmese language.

Madras, April 17, 1888.

The following promotions are made:—

Mr. J. J. Whiteley, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank with effect from 27th March 1888.

Honorary Lieutenant and Deputy Assistant Commissary J. A. Power, Sub-Engineer, sub. *pro tem.*, 2nd grade, to Assistant Engineer, 3rd grade, Supernumerary permanent, with effect from 20th November 1887.

Punjab, April 19, 1888.

With reference to Government of India, Public Works Department Notification, dated the 14th December 1887, and in continuation of Punjab P. W. D. Notifications, dated the 21st ultimo, Mr. W. H. Parker, Superintending Engineer, is appointed Engineer-in-Chief of the Patiala Railway, including the Bhatinda-Bahawalpur Railway Survey, with effect from the date on which he assumed charge.

Irrigation Branch.

Mr. C. E. Day, Executive Engineer, 3rd grade, attached to the Karnal Division, Western Jumna Canal, is allowed furlough for twenty-two months, with effect from the 8th May 1888 or such subsequent date as he may avail himself of the same.

India, April 21, 1888.

Major W. H. Coaker, R.E., Superintending Engineer, 3rd class, temporary rank, State Railways, reverted to his substantive rank of Executive Engineer, 1st grade, with effect from the afternoon of the 23rd February 1888.

Lieutenant J. E. Capper, R.E., Assistant Engineer, 1st grade, temporarily employed in the Military Works Department, and now on furlough, is retransferred to the Central Provinces.

Mr. W. B. Harington, Executive Engineer, 1st grade, Punjab, is permitted to retire from the Public Works Department, with effect from the 19th March 1888.

Rajputana.

Furlough to Mr. Campbell Thomson, Executive Engineer, Meywar State, is granted for six months only, instead of twelve months.

Military Works Department.

Lieutenant W. W. Baker, R.E., Assistant Engineer, 1st grade, is appointed to officiate as Executive Engineer of the Kurrachee Defence Division.

Lieutenant C. E. Norton, R.E., Assistant Engineer, 1st grade, passed the Departmental standard examination on the 17th March 1888.

Director-General of Railways.

Mr. R. F. Coppin, Assistant Engineer, is transferred from the Bannu Railway Survey to the North-Western Railway.

N.-W. P. and Oudh, April 21, 1888

Irrigation Branch.

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner, Oudh, is pleased to order the following reversions and promotions, with effect from the dates specified:—

Mr. J. H. A. Ivens, from Executive Engineer, 4th grade, sub. *pro tem.* to Executive Engineer, 4th grade, temporary rank, from 13th

February 1888. Consequent on the return of Mr. Coles from furlough.

Mr. J. A. Cones, from Executive Engineer, 4th grade, temporary, rank to Assistant Engineer, 1st grade, from 13th February. Consequent on the return of Mr. Coles from furlough.

Mr. J. H. A. Ivens, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub *pro tem.*, from 16th February, 1888 *vice* Mr. Dodsworth, whose services have been dispensed with.

Mr. J. A. Cones, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, from 16th February 1888 *vice* Mr. Dodsworth, whose services have been dispensed with.

Rai Priyanath Ghose, Sahib, from Assistant Engineer, 1st grade to Executive Engineer, 4th grade temporary rank, from 18th March 1888 *vice* Mr. Thornhill on furlough.

Mr. A. M. Fagan, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, from 22nd March 1888 *vice* Mr. Barron, on furlough.

Mr. A. C. Evans, Executive Engineer, 3rd grade, sub *pro tem.*, is appointed to officiate as Executive Engineer, Etawah Division, Lower Ganges Canal, during the absence of Mr. H. Marsh on privilege leave, or until further orders.

Buildings and Roads Branch.

Colonel J. G. Forbes, R.E., Chief Engineer, Irrigation Branch, and Secretary to Government, North-Western Provinces and Oudh, Public Works Department, assumes charge, in addition to his own duties, of the Office of Chief Engineer, Buildings and Roads Branch, and Joint Secretary to Government, North-Western Provinces and Oudh, Public Works Department, *vice* Colonel D. Ward, R.E., deceased.

Bengal, April 25, 1888.

Establishment—General.

Mr. M. H. Jackson, Assistant Engineer, is posted to the 1st Calcutta Division.

Mr. W. B. Gwyther, Officiating Executive Engineer, 2nd Calcutta Division, is posted to the Chief Engineer's Office.

Mr. J. H. Toogood, Executive Engineer in charge of the Calcutta Workshops, is transferred to the 2nd Calcutta Division.

Mr. J. Bradshaw, Sub-Engineer, attached to the Balasore Division, is appointed as a temporary measure to hold charge of the Calcutta Workshops.

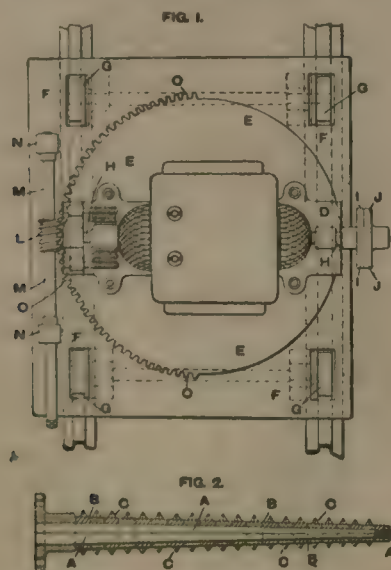
Establishment—Irrigation.

Rai Kali Podo Sen, Sahib, Assistant Engineer, is posted to the Brahmini-Byturni Division, which he joined on the forenoon of the 17th instant.

Indian Engineering Patent Register.

RECENT BRITISH PATENTS.

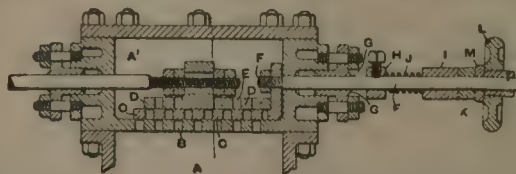
APPARATUS FOR CUTTING COAL.—*T. Bower, R. W. Bower, and J. Blackburn, Woodlesford, Yorkshire.*—The object of this invention is to improve the construction of the cutters, and also to simplify the means employed for its operation. The cutter bars are made of such a form that they can more readily be withdrawn from the work. A section of the improved form is shown in *fig. 2*. The cutter bar A is made of taper form towards its outer extremity, and the cutters B are gradually reduced in size. The base of the cutters B may be of polygonal form, and diamond-pointed steel bits C are screwed into them. When electricity has been used for driving these bars, the motor has usually been constructed separate and distinct from the machine. According to this in-



vention the motor is coupled directly to the machine as illustrated in plan in *fig. 1*. An Immisch motor D is mounted on a turntable E carried on a bed plate F. The wheels G support the whole frame work. The motor shaft H has a coupling plate I at its end, corresponding with another plate J on the cutter bar A. The rotary motion is imparted to the turntable by means of a worm L mounted on a shaft M, and the gearing O on the rim of the table E. Any other motor may be applied

for this purpose besides the Immisch. The inventors make two claims: (1) For the form of the cutter bar; (2) for the disposition of the motor and the gearing for the operation of the machine.—No. 16955. December 9th, 1887.

VALVE GEAR.—*A. H. Chartres, Derby.*—This invention relates to the construction and arrangement of an improved variable cut-off gear for steam engines. The accompanying figure represents a horizontal section through the essential parts. A slide valve (not shown) is arranged for admitting steam to the cylinder, and in the steam chest A a number of ports B are formed. The movable port plate C and the valve plate D work in a separate steam chest A'. The slide valve of the engine is worked from the main shaft, and the valve plate D is similarly worked, but at double the speed. The plate C is worked by the governor, and it is arranged so as to travel intermittently over the ports B in the fixed port plate and the valve plate. This motion is effected by a rod, the collar H, and the spring J. A bevelled surface is formed outside, and is arranged to work with the wedge K, which is connected by a lever with the governor. A wheel L serves to adjust a collar on the step M to or from the wedge K, so as to check its to and fro motion, and so regulates the throw of the movable port plate C. Any racing in the engine will act on the governor in the usual



way, and the motion of the governor is communicated to the movable port plate C. This movement of the plate over the ports will partly or wholly cut off the steam from the main valve chest, and the regulation of the wedge K determines the amount of cut-off and expansion to be allowed. The details of the mechanism for operating the movable plate may be varied by forming a rack on the stem of the plate, gearing with a toothed quadrant actuated by the governor. In this case no check spring will be required. The inventor makes three claims for this cut-off gear—No. 3681. March 10th, 1887.

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Depôt—Sulkea, Calcutta.

NOTICE.

Bengal-Nagpur Railway.

1st. Sealed tenders for the supply of 30,000 cubic feet of teakwood scantlings required for the construction of Broad Gauge Railway Carriages in the Nagpur Workshops, B.N. Railway, will be received by the Agent up to noon of the 30th May and will be opened by him then and there in the presence of all parties who may choose to attend.

2nd. The timber to be seasoned and sound, cut perfectly straight and square to be free from knots, flaws or cracks. Sizes of scantlings, and terms and conditions of tender along with form of tender may be obtained from Locomotive and Carriage Superintendent, B.N. Railway, Nagpur.

3rd. Seals of tenderers unable to write will not be accepted; they should have their marks verified by witnesses.

4th. Covers to be superscribed "Tender for Teakwood scantlings for Bengal-Nagpur Railway."

5th. The tender may be in part or for whole requirement, and the Agent reserves to himself the right to accept in whole or in part, but in the event of his accepting in part only, and the tenderer failing to take up the contract, the whole earnest deposit will be confiscated.

6th. Tenders without earnest money of Rs. 1,000 will not be attended to.

7th. The Agent reserves to himself the power of rejecting any tender without assigning a reason, and does not bind himself to accept the lowest or any tender.

NAGPUR; } (115)
9th April 1888. }

T. R. WYNNE,
Agent and Chief Engineer.

In the matter of the Indian Companies Act, 1882.

AND

In the matter of the Deoghur Mining Company, Ltd.
FOR SALE.

THE mining and other rights of the above Company in Mouzahs Toolsitar, Loth Bedooa, Churkidangi, Bissenpore, and Mongua Reidee, in Talook Ropinee in the Sub-district of Deoghur, in the Sonthal Pergunnahs, comprising 6,057 biggahs, or thereabouts, under a lease, dated the 29th May 1883, for 149 years from 29th May 1883, and as to Mouzahs Toolsitar and Churkidangi under conveyances from the Mustagirs thereof respectively.

2—The Engines, Plant, Machinery, and Stores of the above Company, at Deoghur, including (among other things)

- 1—Tubular Engine Boiler with fittings complete.
- 1—Tangye's Vertical Boiler with fittings complete.
- 1—Winding Engine with fly wheel and drum.
- 2—Special pumps.
- 1—Crab winch.

For full particulars apply to the undersigned, by whom offers will be received up to the 31st May 1888.

DIGNAM, ROBINSON & SPARKES,

*Attorneys for the Liquidator
of the abovenamed Company.*

4, STRAND, CALCUTTA; }
24th April 1888.

SALE OF IRON PADDLE STEAMER.

TENDERS for the purchase of the Madras Government Steam Tug *Madras*, built at Blackwall by T. A. Young in 1876, will be received by the Port Officer at Madras up to noon of Tuesday, the 1st May 1888.

2. The vessel will be sold at Calcutta with engines, boilers, masts, sails, awnings, spars, anchors, cables, boats, and such other stores as may be on board on the 30th March and which will not be removed previous to the sale.

3. Each tender, before being opened, must be accompanied by a treasury receipt for a sum equal to 25 per cent. of the amount offered, and the balance must be paid within 48 hours of acceptance of the tender and before delivery is taken. The tenders will be submitted to the Government of Madras for orders.

4. The vessel will be at the risk and charge of the purchaser from the date the acceptance of the tender by Government is communicated to him.

5. The following description of the vessel is believed to be correct, but any errors or misdescription shall not annul the sale, nor shall any compensation be allowed on that account:—

Tonnage	...	197 gross.
Do.	...	57 nett.
When built	...	In the year 1876.
Where built	...	At Blackwall.
Extreme length	...	123 feet 4 inches,
Do. breadth...	...	20 feet 8 inches.
Depth	...	11 feet 1 inch.
Number of bulkheads	...	Three.
Do. of decks...	...	One.
Engines	...	Two side lever disconnecting surface condensing.
Boilers	...	One multitubular.
Horse-power indicated	...	137.
Do. nominal	...	75
Coal that can be stowed in bunkers	...	66 tons.

6. The vessel will be open for inspection at Calcutta on applying for an order to the Deputy Director of India Marine on or after the 30th March 1888.

MADRAS PORT OFFICE, } H. A. STREET, CAPT.,
15th March 1888. } H. M.'s INDIAN MARINE, Port Officer.

(106)

DIVING APPARATUS FOR SALE.

A Siebe and Gorman new air engine to supply two divers simultaneously, two suits of diving dresses, helmets, piping and all complete in two chests, the whole lot as good as new, having been used only a few days, lately cost in England £154 sterling.

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2. The applications, with copies of testimonials, will be received by the undersigned up to the 30th April 1888.

(Sd.) G. W. DISNEY, C.E.,

District Engineer.

MOZUFFERPORE.

The 10th April 1888. }

(114)

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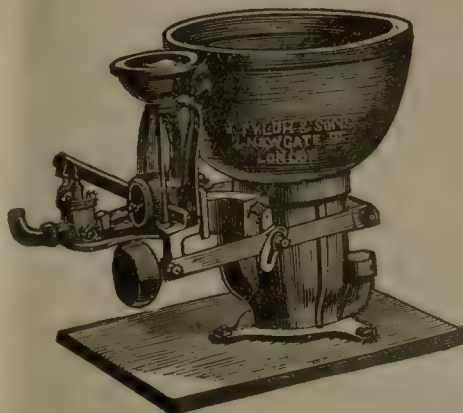
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*Mechanical Engineer,
PROPRIETOR.*

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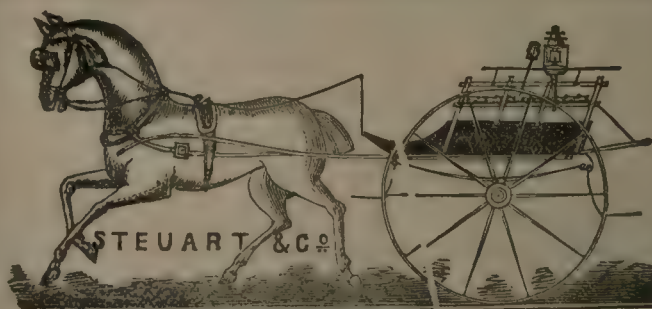
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INDIAN ENGINEERING.

SATURDAY, MAY 5, 1888.

TECHNICAL EDUCATION.

WE read that "Messrs. Maple & Co. (of London) have done wonders with the furnishing and decorating of the new (Viceregal) Palace on the Hills." To fully comprehend the meaning of this sentence, one must recall to mind the amount of money Government has spent in professing to advance technical education in India, and thence will arise the reflection that while Local Governments and experts are gravely debating the details of technical education, the Government of India by playing directly into the hands of British manufacturers is effectually rendering these efforts abortive. There is a broad question connected with Art Industries into which we do not desire to enter, viz., whether Great Britain is to become the workshop of our Colonies, and to receive in exchange agricultural and other produce. We think that with extended railway communication much may be said in favor of this view, and that the authorities either take this view, or are compelled to take it by manufacturing interests in England, the action of the Government of India leaves little room to doubt. If this is actually the case, why not say so? Why is the position not boldly acknowledged, and the cry of technical education dropped? No harm would be done, and India would not suffer, except perhaps during famines, but when we find a Government professing one thing and performing acts opposed to its professions, all who pay rates and taxes have just cause for complaint for the State might at least be spared the expense of maintaining enthusiasts and costly establishments which from the outset may never really be intended to serve their end. All mill industries and such like may be safely left to take care of themselves, but perfection in the Industrial Arts can be attained by actual practice alone, and if Government never under any circumstances permits this practice, the united efforts of all the technical establishments throughout India in a series of years would not produce so simple a thing as the proverbial candle-box. No one would venture for a moment to assert that Messrs. Maple and Co.'s furniture and decorations will not be more chaste than anything executed in this country, but we unhesitatingly assert that the differences between them would not be appreciated by more than, say, 1 per cent. of the people who will look at them. If proof is wanted of this assertion, we would recall a sentence which appeared in a Bombay leading paper describing some recent local decorations as calculated to make Mr. Crace's mouth water! So much for decorations. In the matter of furniture, the productions of Messrs. Deschamps, of Madras, in renaissance, and Messrs Wembridge, of Bombay, in adaptations of modern work far surpass anything exhibited at the Exhibition of 1851 where the artistic spirit of the people fastened its admiring gaze on a sideboard produced by Messrs. Cox

& Co., "entirely by machinery," and surely what was good enough for our fathers, 37 years ago, is good enough for a Viceregal Palace on the snowy mountains. These facts seem to us to render the act of the Supreme Government absolutely indefensible from any point of view than that we have noted, *viz.*, the encouragement of the importation of foreign works of Industrial Art. There is another evil in importing from England, we move slowly here, and they move fast there, local productions would not materially age in design, while English art fashions change so rapidly that Messrs. Maple & Co. will probably smile in pity five years hence at what is passing now as the height of artistic excellence.

B. C. E.

WE have before us the Calendars of the three Indian Universities for this year, and as we consider it may be instructive we propose to compare the tests required for the degree of B. C. E. at each University, both from an educational and professional standpoint.

In Calcutta, any candidate who has passed the First Examination in Arts, may be admitted on producing a certificate from the head of an institution affiliated to the University in Engineering, shewing that he has prosecuted a regular course of study for one year after passing the First Examination in Engineering. In Madras, the candidate must have completed two years from the time of passing the First Examination in Arts either in this or one of the other Indian Universities. In Bombay, for the degree of L. C. E. the candidate must have matriculated at some University, and must have kept six terms in a School or College of Engineering recognized by the University subsequently to having matriculated. There is no degree of B. C. E.

The length of course prescribed at each University is exactly the same: *viz.*, two years after matriculation. There is only one examination in Engineering for the degree of L. C. E. and B. C. E., but for the latter degree the candidate must have passed the First Examination in Arts at the University, instead of the ordinary Entrance Examination. In Calcutta and Bombay, the candidate must pass the First Examination in Engineering, whereas in Madras, there is only one examination, *viz.*, that for the degree. We have compared the subjects of study prescribed at each University for the Matriculation and First Arts Examinations, and we find them to be almost identical. The subjects have been carefully selected and comprise English, one Optional Language, Mathematics, Elementary Physics, History, and Logic. Considering the very technical nature of an Engineer's education, and that the majority of the students are Natives, to whom English is a foreign language, we think our readers will agree with us when we state our opinion that every candidate for the Engineering degree should possess a thorough knowledge of English before being allowed to commence his professional studies. From our experience of the Engineering graduates on this side of India, we consider that the majority of them have not possessed

that knowledge, and have therefore failed to derive full benefit from the lectures of the Professors which are necessarily delivered in English. Our recommendation, therefore, is that no student should be permitted to enter any Engineering class until he has passed the First Examination in Arts. More especially as the Public Service Commission has recently proposed to form two services in the P. W. D.—an Imperial and Provincial—the latter to be recruited locally; in which case we consider that both Government and District Committees have a right to expect a higher class of excellence than they have hitherto been accustomed to receive. The cry is now for local talent, and doubtless it is more or less a just one, but at the same time, if local funds are to be entrusted to the hands of men recruited locally, it is only right that the best men available should be selected. As we have no further observations to make on the preliminary studies of the Engineering student, we will now proceed to consider the course of instruction prescribed for him during his professional training.

The subjects embraced in the two years' course of study at Bombay and Calcutta are sufficiently varied, and in our opinion well chosen. In addition to the subjects taken up in the First Arts Examination, the candidate has to shew a knowledge of Analytical and Geometrical Conics, the Differential and Integral Calculus, and also Geology and Mineralogy. The remaining subjects are purely professional. Except in Bombay, where papers on Optics, Astronomy, Mining, Metallurgy, Botany and Meteorology are also included in the final examination. No doubt every branch of science is useful to the Engineer, but at the same time, as his period of professional training is short, we think that some of the extra papers abovementioned might be advantageously omitted from the Bombay course. After perusal of the Calendars, in our opinion the papers set at the Calcutta examinations seem to follow the "happy medium," and we would commend them to the notice of the sister Universities.

Our suggestions may be briefly summarised. No candidate should be allowed to attend an Engineering class until he has passed the First Examination in Arts. At the end of his first year he should be called upon to pass his First Examination in Engineering, and on passing the required standard at the end of his second year, he should be granted the degree of L. C. E. Optional papers on certain selected subjects, such as Applied Mechanics, Hydraulic and Descriptive Engineering should also be set at the same examination, and the degree of B. C. E. should be reserved for those candidates who pass creditably in the optional subjects.

P. W. D. ASPECT OF THE FINANCIAL BUDGET.

THERE is a deep meaning underlying the reticence of the Government of India in the matter of the publication of the Financial Budget, and even the representations of influential bodies, such as the local Chamber of

Commerce, the Trades Association, the British Indian Association, &c., have not achieved much success in persuading the Government to deviate from its "plan of campaign." The latter has succeeded admirably well, although at the cost of a little prestige. But why a reply in the usual stereotyped form,—His Excellency the Viceroy sees no reason to re-open the question,—was not given, we are at a loss to determine. Strictly speaking, the wind had been taken out of the sails of the memorialists by the declaration made in that admirable and lucid speech by Mr. W. J. Westland in January last, introducing the duty on salt and petroleum followed soon after by the submission of an "Appropriation Account," which only helped to render darkness visible by manipulating figures such as our Government alone is capable of doing. To pile up the agony of rate-payers this has been followed up by the usual Budget, particulars of which no one but the Executive were aware, the Legislative portion of the Imperial Council being left out in the cold. From the STATEMENT before us we find that although "Railways form a very important part of revenue and expenditure, the arrangement of the accounts, following, as it does, the somewhat complicated differences in the relations of Government to the different Railways, does not very clearly set forth the purely financial part of their history." But there is "Balm in Gilead," and an abstract of the transactions of ten years.....will render the position clearer. In the Statement referred to, the construction of Guaranteed Railways had come to a close, the principal exception being the expenditure in regard to the Oudh and Rohilkhund Railway. The account of interest in sterling, which represents this part of the capital, rises from £4,737,000 in the first year to £4,827,000 in the sixth year. In the meantime the construction of State Railways was in active progress, and the Indian interest account was being added to regularly by about Rx. 2,00,000 every year. Throughout the six years, from 1879-80 to 1884-85, the advance of the net earnings was nearly equal to the advance of charges for interest upon capital. From 1880-81 to 1884-85 the total amount of net earnings was Rx. 3,76,45,000, and the total amount of interest charge (including exchange) was nearly the same, viz., Rx. 3,76,89,000. In other words, in years which produced bad revenue the net earnings fell short of the interest by a million, and in years when the revenue was good they nearly exceeded it by half-a-million. There is, however, one point to be considered in connection with this subject—a good deal of deduction has to be made from the earnings before they can be made available for Railway charges. The companies are entitled to a share of the earnings which amount to about Rx. 7,00,000, if to this were added a further sum varying from Rx. 1,50,000 to Rx. 2,00,000 for Government establishments, surveys, &c. in connection with those Railways, we find that when their earnings are equivalent to the interest on capital, the Government must suffer heavy annual losses. During the above-mentioned five years the loss averaged about Rx. 8,00,000, but since 1885 it has been steadily and considerably increasing and the Revised and Budget Estimate

show it to be Rx. 21,50,000. This deterioration is not due to the falling-off in the revenue, for that indicates a normal figure, but it may be attributed to the interest paid in England, the fall in the exchange, and the burden created by the South Mahratta, the Bengal-Nagpur, and the Indian Midland, which operates as a dead-weight, as the capital on which interest is being paid is barely remunerative. But this undesirable state of affairs, it is hoped, will come to an end in another year or two. This, of course, applies to the new companies. In regard to the older ones the new burden is confined to exchange. The Budget shews that from 1880-81 to 1884-85 the exchange has varied considerably. That is, it has been for every £100 Rx. 24·3, Rx. 31·5, Rx. 37·6, Rx. 42 and Rx. 42, and this for a sterling charge of £4,900,000 means an additional increase of exchange to the extent of Rx. 2,20,000 for four years. Under the head of Telegraphs the Revenue Account shews a satisfactory surplus. This surplus was for the last three completed years Rx. 1,29,000, Rx. 79,000 and Rx. 1,74,000.

In the matter of Irrigation the accounts are classified under two heads, Major Works, or those the construction of which is charged outside the Revenue Account or to the Protective Grant, and which is charged with interest payable on the cost of construction; and Minor Works, or those in which capital expenditure and maintenance are charged in Revenue Account. In the former there was a falling-off in the revenue, owing in one place to a year of abundant rain supply, and in the destruction by floods of an aqueduct close to the head of the Lower Ganges Canal, and until the work is repaired the revenue must remain low. The cost for restoring it is estimated at over Rx. 4,42,000 and will add permanently Rx. 17,700 to the account of interest. The Government of Madras has undertaken to lay out in Minor Works Rx. 50,000 or Rx. 60,000 for some years to come, in return for which it expects a large addition to the land revenue.

We now come to Civil and Military Works. For the last eight years the Government of India has appropriated an annual sum of Rx. 10,00,000 for Military Works, including fortifications, military roads, &c. The carrying out of the Civil Works rests almost entirely with the Provincial Governments. In 1885-86 the expenditure on Military Works was Rx. 9,60,415, against Rx. 9,43,344 in 1884-85. In regard to Civil Works the expenditure in 1885-86 was Rx. 3,50,452, against Rx. 4,65,169 in the previous year. Subsequently, however, a sum of Rx. 2,00,000 a year is being yearly set aside for the construction of frontier roads in Punjab and Beluchistan, besides roads and buildings required for Civil and Military purposes in Upper Burma. The net expenditure under all these heads throughout India, including exchange, is as follows: in 1886-87 Rx. 15,66,131, in 1887-88 Rx. 22,30,600, and in 1888-89 Rx. 20,22,600.

BENGAL RAILWAYS.

ONE of the most interesting chapters in the last Administration Report of the Bengal Presidency is that on Provincial Railways. Pessimists who look with distrust

on all movements bearing upon the regeneration of India, will have little to congratulate themselves upon such results; while those who watch with earnestness the course of events, will find enough to cheer them on their way. There are important issues involved in connection with this subject. The remarkable progress made in the extension of railways, followed by a steady increase in trade, during the last five years is highly satisfactory. But activity in this direction was observable more in the completion and consolidation of various projects than in the inauguration of new schemes. Important changes were wrought during the five years of the Provincial Financial Contract, which were also coincident with Sir Rivers Thompson's government of the Province. The development of the lines already in existence was followed by an expansion in the revenues, as the returns abundantly prove. The gross receipts from the State Railways of Bengal, which amounted in 1881-82 to 32½ lakhs, have during the quinquennial period satisfactorily risen to 53 lakhs. Working expenses have also kept pace with the addition of new lines, and the extension of old ones. In 1881-82 it was 19 lakhs, and in the year under review 32 lakhs, leaving a net revenue which had risen from 13½ lakhs in the former year to 21 lakhs in 1886-87. The Patna-Gya, the Nalhati and the Kaunia-Dharla lines have not shown much elasticity in their working results, but the others exhibit a progressive increase with each year. The Lieutenant-Governor, however, singles out the Northern Bengal State Railway, and points with commendable pride to the steady advance made not only in its earnings, but the effect the line has had in giving an impulse to the extension of trade and the consequent improvement in the material condition of the people. As we have already in a recent number of this Journal given an account of the general working of the East Indian (Imperial) Railway, we will not stop here to repeat what we said on a former occasion, we will therefore pass on to the others. Tarkeswar (Assisted) Railway gave a dividend of 6½ per cent to the shareholders. The Administration Report, referring to the coaching traffic on this line, says, it is a significant fact that out of Rs. 2,38,444 of receipts for 1886, Rs. 2,16,004 were contributed by third-class passengers alone. This need not surprise any one who is aware of the fact that Tarkeswar has a famous shrine to which people from all parts of India—from Cape Comorin to the Himalayas, and from the Punjab to Chittagong—resort in large numbers on pilgrimage; the majority of whom are from the lower orders, whose means do not permit them to travel first or even second-class. The Patna-Gya (Provincial) State Railway shewed higher earnings from passenger traffic in 1886 than in any previous year. The earnings per mile open per week were Rs. 180; the entire capital outlay to the end of 1886-87 was Rs. 42,40,742. The Eastern Bengal (Imperial) State Railway comes next under notice. As our readers are probably aware this line is the chief mode of communication between Naraingunge and Serajgunge, two of the principal marts in Eastern Bengal for jute and rice, and Calcutta. The rate charged for carrying

jute from those two ports was below the rate for previous years, therefore, as might have been expected from the circumstances of the case, a larger quantity (54,69,587 maunds) was carried by the railway during the calendar year than in any previous year with the exception of 1882. The receipts for 1886-87 amounted to Rs. 53,71,360 and expenditure to Rs. 32,67,561, leaving net receipts of Rs. 21,03,709, representing a little over 4 per cent. upon the capital outlay of Rs. 5,22,89,987. The Bengal Central (Assisted) Railway was worked at a loss of Rs. 15,288, although there was an increase of Rs. 26,000 in passengers and of Rs. 23,000 in goods. This line, running through a tract of land intersected by rivers and creeks, it has to work in the teeth of keen competition with boats and little steam launches. It is, however, hoped that with the opening of the Jubilee Bridge and the direct connection made with the East Indian Railway, it may have the effect of enabling the railway to compete on better terms with country boats. The Dacca-Mymensingh (Provincial) State Railway, of which great results were expected as opening up the jute and rice tracts of Eastern Bengal, has not done at all well; it worked at a loss of Rs. 57,347 in 1885-86, and in the following year of Rs. 7,028, causing a net loss to Bengal of Rs. 2,79,724. The Northern Bengal (Provincial) State Railway shews good results. The capital cost of the line up to the end of the year was Rs. 2,27,90,420. There was a very large increase in the grain and jute traffic, the latter being the principal staple carried on this line; the gross receipts were Rs. 26,24,013, and the working expenses Rs. 14,11,742, leaving net receipts of Rs. 12,12,271, giving a profit to Bengal of Rs. 3,76,110. The capital outlay on the Kaunia-Dharla (Provincial) State Railway to the end of the year was Rs. 9,64,134, and the net receipts Rs. 33,140, representing a percentage of 3.43 on capital cost of the line. The Tirhoot (Provincial) State Railway suffered greatly from the floods of 1886, but the works stood the strain satisfactorily with the exception of the failure of one culvert. The gross receipts were in 1886-87 Rs. 15,99,212 and the expenditure Rs. 9,85,827, leaving net receipts of Rs. 6,13,385. Since the reduction of third-class fare in 1883 the passenger traffic has increased by leaps and bounds. In that year it carried 655 thousand passengers while, in 1886 it rose to 1,761 thousand, which gives the earnings at Rs. 5,36,000. The Darjeeling-Himalayan (Assisted) Railway worked very satisfactorily during the year. Passenger traffic kept going steadily. A sum of Rs. 30,000, which was transferred as a loan in 1885-86 from revenue to capital, was re-transferred this year to the credit of the revenue account, and distributed among the shareholders. The total capital outlay to the end of December 1886 was Rs. 26,83,035, and a dividend of 8 per cent was declared. There was an increase of 5,000 passengers in 1886-87 as compared with the previous year, and of about 73,000 maunds of goods carried. "This little railway," says the report, "is of a type that has not been worked in any other country," and Mr. F. Prestage, under whose management it has been carried, has fairly earned the credit of its success.

Notes and Comments.

MADRAS P. W. D. ITEMS.—Notice is given that the address of the Periyar Division Office will be Madura till further intimation. The office of the Executive Engineer, Buckingham Canal Division, has been removed from Pulicat to the Madras Basin, Rayapuram. The Canals of the Kistna Delta will be closed for repairs up to the 1st June, and those of the Gadavari up to the end of May.

Engineer of the district. Where the cost of the proposed work exceeds Rs. 10,000, but does not exceed Rs. 20,000, the plan and estimate may be sanctioned by the Commissioner after obtaining the approval of the Superintending Engineer.

THE YELLOW RIVER PROBLEM.—The following purports to be a solution of the difficult problem of preventing the devastating inundations so frequently made by the Yellow River:—"The difficulty to deal with is the silt. Free the river channel from this, leave it behind, by distributing it over the adjoining lands, and impounding it there in ---"

A COMING OFFICIAL PUBLICATION.—Mr. W. W. Robinson, of the P. W. D. in Burma, has prepared formulæ and tables for determining the scantlings, beams and joists of all timbers for Engineering purposes. It claims the advantage that the scantlings of any kind of timber required for any design for a building of any kind can be found by the simple multiplication of two numbers, and for any weight and any ratio of depth to breadth of beam. The tables have been approved by Colonel W. G. Cumming, R.E., the Chief Engineer of the Province and they are to be printed at the Government Press.

FRONTIER DEFENCES.—A correspondent of the *Pioneer* confirms the disgraceful state into which the road through the Kohat Pass has been allowed to fall of late years. This is the only direct route by which communication can be kept up between Peshawar and Kohat, the two most important garrisons on the border, and some of the most warlike tribes hold the adjacent country. The military authorities are well aware of the danger which may arise from the road being untouched year after year; and yet no steps are taken to apply a remedy. The plea of shortness of funds cannot be applied in this case, for liberal subsidies are paid to the tribes holding the Pass to keep the road in repair.

A BRIGHT PROMISE.—When the Periyar dam is finished the entire aspect of the surrounding country will be changed, the beautiful and richly wooded valley drained by the Periyar and its larger tributaries being converted into a vast lake that will wind in and out of the hills, its sinuous length extending, according to Colonel Pennycuik's computation, 16 miles inland. The lake will be one of the most beautiful in the world, for it will rest among magnificent forest-clad mountains and rolling grassy uplands, having a rich growth of bamboos and other tropical vegetation down to its edge. Two little steamers or steam-launches are to ply on it, and will no doubt make the lake a popular resort among idlers and sportsmen.

COLOMBO WATER-SUPPLY.—Considerable annoyance was caused the other day to residents in Colombo, by the sudden stoppage of their water-supply. On inquiry, it was found that one of the main pipes had burst, necessitating a repair of the same. This was done without previous notification to the general public, and as it involved

the temporary stoppage of the water-supply, caused much inconvenience, bringing home to the minds of many the great disturbance which would be created by any accident at Labugama which would cut off the supply for a number of days, now that the Maligakanda reservoir is so utterly useless. This reminds us that nothing has been heard as to the intentions of the Government with respect to this reservoir. It is time the public were afforded some information on the subject.

UNFAIR COMPETITION—AGAIN!—In 1886 The Madras Government made a profit of Rs. 27,920 on its printing work. And yet Government is always making profession of desire to avoid competition with private trade; and injury to it. Free trade is all very well in its proper place; but there ought to be no room for such a gospel in a Government printing press. Fair trade would be a more seemly, more dignified, more honest watchword within the four corners of a Government office. If on its own account it cannot find enough work to keep its printing works going, the obvious remedy is reduction of establishment—a remedy that it enforces without the least compunction in its other departments. It is a woman's privilege to be inconsistent, but not a Government's—even with an old woman like Sir Duff, K.C.S.I., at the head of affairs.

E. I. RAILWAY HEDGES.—Somebody says: Government insist on every railway line being "protected by durable and sufficient hedging or fencing." This is all very well, and would answer the purpose, if Railway managers could all agree upon some definite idea of the "durable and sufficient." On many miles of line on the E. I. Railway, all the "durable" fencing one sees is a small pile of stones heaped one over the other loosely, only high enough to prevent a four-year-old baby crossing, but certainly much too low to prevent a sheep or a cow from stepping over. In other cases the wire fencing is so low as scarcely to prevent anything crossing. The object of the order was to protect the trains from derailment by running over buffaloes and the like, but the latest list of derailments caused by cattle proves that the hedges and fences do not serve the purpose for which they were intended.

OTHER ASPECTS OF OUR FRONTIER RAILWAYS.—A Service paper at home says:—Assuming, for the sake of argument, that the frontier railways are useless from a most insane project. I have asked some of the best informed of public men here, and no one can give a rational account of how and why the measure was carried. One great objection is that the Hooghly may be so silted up, notwithstanding Engineering efforts, at and near Calcutta as to render the docks quite useless. People, not a few, say that we may some day have to make Diamond Harbor, half way down to the mouths, the port. Where will the docks then be? Again, it is strongly believed that these docks will become so stagnant as to poison the whole city. Ever so many millions to be spent just for a project to poison the great city, or when the state of the river will require it to be closed! As for port accommodation at present, there is quite enough of space in the river for twice, and even three times the number of vessels one usually sees in it. When, too, Government is so hard up, to throw away so much money, is inexcusable. In the same way, on a mere 'fad,' the Seebpore Engineering College is kept up. If this College, and the other Government colleges in Bengal were given up, there would be a very appreciable saving, and if

there is no more money spent on the docks, it would be another sign of wisdom and economy. But—and you will not believe it—they are crying out for another bridge of a heavy character to take the place of the present floating one! The horse-leech hath two daughters crying “give—give!”

THE GOVERNMENT ASTRONOMER RE AN ELECTRIC CLOCK.—Respecting the erection of a third electrical clock, under continuous control of the normal mean time regulator at the Observatory at Madras, Mr. Pogson says: “I must most decidedly protest against the erection of any public clock in Madras, for the regulation of which I am to be held responsible, facing southwards. Throughout the greater part of the year, i.e., from the middle of February to the beginning of October, the prevalent winds are from the south or south-west, and especially during the first four months of that period, when there is little and often no rain, the sand and red dust would be blown straight against the clock's face so as to defy all possibility of keeping the works in going condition. The sun would also shine full upon the face for so many hours daily, that, unless it were so sheltered as to be almost obscured from view, the oil would inevitably dry up and the clock would be always stopping and out of order. I am sure Messrs. P. Orr and Sons would not care to undertake the cleaning or repairs of a clock so exposed, well knowing the inevitable dissatisfaction it would give rise to. If placed facing northward, however, it would suffer comparatively little from dust, the winds blowing from a northerly direction only during the rainy cool season, and it might easily be shaded from sunshine, which would scarcely affect it throughout the year. I therefore request that, whatever site may be selected, the clock may face the north.” The Government approve of the electric clock being erected as recommended by the Government Astronomer.

THE RECORDS OF THE GEOLOGICAL SURVEY OF INDIA.—The November issue of the Records, which have already been noticed, contains notes of Himalayan Geology, by Mr. Oldham, from which we find that his attention has been directed of late to attempt at elucidation of sundry doubtful points with regard to the sequence of sedimentary formations in the lower Himalayas. His first point of attraction is the limestone of the Naira Valley, where a massive limestone is exposed, some of the beds having a strong sulphurous odour. As regards lithological appearance it is said not to differ markedly from the characteristics shewn in previous exhibits. Below the village of Lana is a bed of supposedly glacial origin, consisting of rounded waterworn boulders of quartzite, imbedded in a fine grained, red coloured, subchistose matrix. On the spur south of the Minas-gadh, in the Deora Valley of Jubal, Mr. Oldham found volcanic beds associated with black carbonaceous slates—the same sort of beds Colonel McMahon found in the Sutlej Valley, and correlated with the volcanics of Dalhousie and Kashmir. Mr. Oldham writes, “I was able to make one observation which has an important bearing on the mode of intrusion of the granite. On the spur south of the Minas-gadh the black carbonaceous slates are overlaid by the volcanic beds noticed above, here changed into hornblende schists and mica traps. On the spur north of the Minas-gadh no trace of these rocks can be seen, but in their stead is an exposure of rock which only differs from the porphyritic rock of the Chor at large, inasmuch as the matrix is highly hornblendic and dark coloured.”

Current News.

It is believed that Captain Burn and Major Rowan Hamilton will remain on the staff of the new Viceroy.

THE Honorable Sir Charles Aichison has been permitted to resign the Bengal Civil Service from the 2nd April.

THE condition of the Emperor of Germany's health is less satisfactory. His Imperial Majesty is now troubled nightly with cough.

RAILWAY communication on the broad gauge between Sibi and Quetta by way of the Bolan Pass will, it is hoped, be ready by September next.

THE Chamber of Deputies has passed the Bill authorizing the Panama Canal Company to issue a lottery loan of three hundred and forty million francs.

It is reported that Messrs. Gillanders, Arbuthnot, and Company have sent an agent to the ruby mines with a view to making an offer to Government for working them.

THE only other fresh item of news regarding the Deccan Mining Scandal is that Mr. Watson has written to the *Times* declaring his ability to refute the charges and dispel the illusions prevalent regarding the Company.

THE *Deccan Times* hears that for the present His Highness the Nizam's Government does not propose to appoint a Director to the Mining and Railway Companies, as it is not considered necessary to fill the vacancy at once.

ON Monday last a fire broke out in the village of Dehhoo, in a sugar-cane godown belonging to one Nanarayan Patlogee Thorthoh. The origin of the fire has not been ascertained, but the damage is estimated at Rs. 150.

A TELEGRAM from Balasore to the Port Officer, Calcutta, says that the American sailing ship *Continental* from New York, has been wrecked off Palmyras. No lives have been lost. The crew were brought to Calcutta in the S.S. *Bassein*.

WE believe that it is practically settled that Colonel Steel, from the Central Provinces, succeeds the late Colonel Ward as Chief Engineer, Buildings and Roads Branch, and Joint Secretary, Public Works Department, North-West Provinces and Oudh.

A MOST destructive fire occurred at the Cawnpore Jute Mill on Sunday evening. The flames were fortunately prevented from reaching the machine room; but the jute and store godowns were gutted. The damage, which is fully covered by insurance, is estimated at three quarters of a lakh.

A COMPREHENSIVE scheme is under consideration in Victoria. It is proposed to construct a reservoir in the Grampians, at a cost of £100,000, capable of holding 76,000,000,000 gallons, for the irrigation of the arid Wimmera Plains. The total cost of the irrigation scheme would be £381,000.

AN enquiry was held by the Coroner at Sion respecting the death of Aitwar Hurjee, a fisherman, 45 years of age. On Wednesday the deceased was attempting to cross the railway line near the Sion Station, when he was knocked down by a train that was proceeding to Coorla, and killed on the spot.

A SAD accident occurred lately at Simla, Mr. Thomas Inwood Pollard, assistant to Messrs. Symes and Company, chemists, died suddenly from the effects of an overdose of laudanum. The deceased was the author of two books on the silver question, and as a writer on Indian political economy was beginning to make a name.

THE conversion of the Nagpur-Chhatisgarh State Railway from metre gauge to broad is being rapidly carried out by the Engineers of the Bengal-Nagpur Railway Company. The rails on the standard gauge have now been laid five miles beyond Raipur, thus enabling heavy material trains to work along nearly 200 miles of the line.

LAST Sunday, just after evening service, a quantity of plaster fell from the roof and walls of the enclosed verandah of the Simla Union Church. Had the accident happened while the people were leaving the church, some one would have been severely hurt or killed, but it was providential that every one had left the church when the plaster fell.

SUKHARAM WALAD KHUNDUO MAHAR in the employ of Mr. Hart Davies, a guard on the G. I. P. Railway after robbing his master of a currency note of Rs. 50 at Dhond came to Poona, where he was apprehended by the Railway Police, and was being taken to

Dhond, but before reaching his destination he jumped out of the Railway train while it was in motion and was killed.

As the O. and R. Railway up-mail train was passing over the Dufferin Bridge at Benares on the afternoon of the 24th instant, one of the *chupprassies* employed by the Railway Company to convey the line clear staff from each end of the bridge, which is connected by telegraph, ran in front of the engine and was mutilated in a most shocking manner, death being instantaneous.

A REPORT upon a proposed railway from Nagpore *via* Umrair Burhampuri, a distance of sixty-five miles, shews that the country, though not hilly, is difficult, and neither timber nor much of the material for masonry can be procured on the spot. The estimated cost of the line, with ample allowance for contingencies, will be twenty lakhs of rupees on the metre gauge, and fifteen lakhs on the 2ft. 6in. gauge.

A CORRESPONDENT hears that Government has sanctioned about 70 lakhs of rupees for the improvement of the canal from Kidderpore down to Shamook Potha, a place 16 or 18 miles south of Kallighat. Tolly's Nullah is a main channel through important places and markets, mainly of rice and other articles from the Sunderbuns quarter. Between 25,000 and 30,000 maunds of rice are daily disposed of at Chitla and Russapugla, respectively.

SPECIMENS of gold ore have been sent to the *Times of Ceylon* and are said to have been discovered in the gem pits at or near Akuresse in the Mowakkorle district, about 34 miles from Galle, by Constable Arrachi. A nugget of almost pure gold valued at 5 sovereigns is also said to have been discovered there. The specimens are nearly pure, and were found in working for gems. The place where they were found is called curiously enough Dayrangalla or 'Burn gold stone.'

MR HUGHES, the Agent of the Hyderabad Deccan Company, has reported to the Directors in England the finding of gold at Raichore in several old workings, and that surveys are being made. He has further informed the Home Board that "Rough washings indicate a very good shew of gold." The Agent has asked for stamp heads, &c., to be sent out from England. Mr. Hughes' deputation with the company will cease on the 15th May, and speculation is rife as to whether he will retire from the survey with which he has been nominally connected of late years.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

INFORMATION SOUGHT.

SIR,—Could you or any of your readers give information on the following point of general interest to steam users.

According to the wording of the Government Notification of the 25th February 1888, rules under section 4, Act III. (B. C.) of 1879, under Rule XVII. the following is to be found :—

Formula for calculating horse-power.

For tubular and internally fired boilers, area of grate multiplied by two=H.-P.

Of course the area should not be taken in square inches, since the number would be a very large one; nor in square yards, as the result would be rather small.

The meaning of the above inferentially is plain enough, though it occurs to me that concerning official notifications it is preferable there should be no room left for inferences, and so I believe the above formula would fall more within the accurate language necessary to formulate if it were set down as—

For tubular and internally fired boilers, area of grate in square feet multiplied by two=H.-P.

But the point on which information is needed is how is the area of the grate to be calculated.

After hunting through several India and Bengal offices I could get no further authentic information than the above formula.

Of course, inferentially again, the matter is plain enough: by grate area should not be meant grate area *plus* dead-plate area, as the dead-plate, often of considerable area, does not in any practical way consume coals and hence does not affect the H.-P. of a boiler, with which last only the above formula professes to deal.

Yet I have to say that out of eight boilers, averaging roughly 50 H.-P. each, in one same concern, on which I have full and reliable particulars, three of them have been classified for H.-P. by taking measurements including the full length and breadth of the dead-plate together with the brick wall over it right round the furnace door frame: three others without including the dead-plate at all.

Notwithstanding my conviction on the matter, which is in

accordance, I believe, with the meaning of the Government Notification, as the above case has occurred to me, I should like to know if it has occurred to anybody else, and if so, if there be any rule or decision passed on the matter.

The only rational way of accounting for the above anomaly I can think of is that subsequent to the classification of the first three boilers, a new order, or new rules, came into force, and that I may not have traced them: so any clue to them would be thankfully received.

G. DUBERN.

NECESSITY OF A MILITARY BRANCH OF P. W. D. FOR MADRAS.

SIR,—We have in Madras several military stations in which the Executive Engineers are civilians. As professional officers they are equally as good, if not better, than military officers, but are totally unacquainted with military regulations, and as they are constantly shifted, do not think it worth their while to acquaint themselves with the army regulations. The result is that where civil officers are in charge they are bounced and bullied into doing works and sanctioning expenditure for the hiring of houses &c., that a military officer would object to; in a word, their ignorance of the rules is taken advantage of. As an instance, when Government quarters are not available for Staff Sergeants and Warrant Officers, it is the duty of the Executive Engineer to hire quarters according to the rank of the subordinates. Till lately the rent allowed by Government for each rank used to be paid to the subordinates, this privilege being abused by subordinates receiving Rs. 30 and hiring quarters for Rs. 7 was stopped and Executive Engineers ordered to hire quarters. The quarters hired by Executive Engineers, especially if civilians, are generally objected to, and the subordinates seek officers' bungalows and make the Executive Engineer pay more than double what is allowed by Government, and the military officer instead of assisting the Engineer backs his subordinate. A case occurred not long ago where a subordinate whose rent was Rs. 12 per mensem hired a house for Rs. 30; the Engineer objected and procured another bungalow, with more than treble the space allowed, for Rs. 18 or 20; the military subordinate would not go into it, and his officer backed him up against the Engineer. In nearly all the military stations there are Government quarters available, but through the Civil Engineer being unacquainted with the army rules, the military subordinates have got into hired quarters and Government has to pay *chowkidars* to look after the empty ones. Another reason for Military Works Branch is to prevent the wastage of public money by the Barrack Department. This department in Bengal and Bombay is under the Public Works Department, but in Madras it is independent. In each military station there are from one to three Barrack Sergeants whose duties are to make weekly inspections and note all damages, but instead of this, each Barrack Sergeant goes about preparing estimates for each work up to Rs. 50. They are not confined to any particular work, but go in for plastering, painting, woodwork, white and color washing and brickwork. Each Barrack Sergeant has a contractor to carry out the repairs. The estimates are sent in every week, and all the Public Works Department has to do is to check and return the estimate with a cheque for the full amount before the work is done. No one is responsible to see that the work is properly done. Considering that the Barrack Sergeants are generally men who can barely write, it is not to be expected that these men could prepare an estimate, and it seems a farce to keep Public Works subordinates in stations where there are two and three Barrack Sergeants who do all the repairs or are supposed to do them. It often turns out, as must be expected, that through inferior materials and bad work the Public Works Department is called on to repair a building that was repaired by a Barrack Sergeant, when all the bad work has to be removed with double the cost.

The Code rule regarding the Barrack Department is, that the Barrack Master, at the requisition of the Officer Commanding, could carry out repairs up to Rs. 50. Except to punkahs, this rule does not mean that Barrack Sergeants are to go weekly and send in an estimate for white washing a part of barrack up to Rs. 50, the next week Rs. 50, on the same barrack, and so on to every building. Regarding the punkahs which it is expressly laid down the Barrack Department is to have nothing to do with, the Barrack Department seems to do just what they like with punkahs, for as soon as the cold weather sets in, every punkah is taken down and thrown into an empty building, and before they are wanted again new frills and all kinds of repairs are done by the Barrack Department, so that of the annual grant for military repairs the best part is spent by the Barrack Department. If there was a Military Branch of the Public Works Department, the same as in Bengal, there would be a saving in the grants for Military Works, and there would be something to shew for the money spent. Buildings in military stations are to be seen in a dilapidated condition for want of funds owing to the large amounts taken annually by the Barrack Department.

PUNKAH.

General Articles.

INUNDATION CANALS.

A STUDY IN FEEDING CREEKS.

Fig. 1 shews a perennial branch of the river and a number of creeks. The portion in continuous lines is roughly produced from an actual survey of the river; the portion in dotted lines is sketched in from a hasty reconnaissance. The most easterly creek runs for about 9 miles independently of the perennial branch, and for about 13 miles independently of the main stream.

The general direction of the course of the river being from north to south, if a line of levels are run from east to west across the whole tract covered by the river in flood, it does not necessarily follow that the water level in all the channels intersected will be the same. The nearest approximation to uniformity of level will doubtless occur in highest flood. At lower states of the river the water will head up in some channels, and have a free escape in others, so that where they run independently from about 9 to 13 miles the differences may be considerable. There are no observations to prove these assertions. The difficulties in the way of making accurate and extensive observations on a wide-spreading and unstable river are too great to induce one to make the attempt.

In the present article, however, I must confine myself to the particular question of the best method of securing a good and certain supply to the Wali Canal. This canal is shewn in *fig. 1* as taking out about 6 miles below the head of the creek. I have not a personal experience with the past working of this creek, but the history is somewhat as follows:—

Season 1884.—The creek was, if not perennial, so free of silt, that it did not require a clearance. The bed level of Wali Canal at C was fixed at R. L. 106·00 or 14·89 feet below maximum flood level at same point. The canal bed was graded to a slope of 1 in 8,000. The canal worked very well.

Season 1885.—Worked well till September, when the creek silted up suddenly.

Season 1886.—Creek cleared to a slope of 1 in 5,000. Persistent silting in creek. In September bund B placed across it below head of Wali Canal.

Season 1887.—Bund B was greatly enlarged and strengthened. Canal bed at C was only cleared to R. L. 109·03 or left 3·0 feet higher. The head of the creek was cleared out. The river was higher than usual all through the season. A great deal more water came into the creek through its own mouth and by spills Nos. 1, 2, &c., shewn by arrows, *fig. 1*, than possibly could be passed down the canals. A current set up along face of bund B. The bund was only saved from destruction by making the spur, shewn as running out from it at right angles. The spur was only made with great expense and trouble. The water then enlarged a small spill, which entailed a further great expense and trouble in the construction of bund A.

It was evident that if possible the expenses, the risks to the crops, and the hardships of 1887 should not be incurred again.

There was not much time for investigation and consideration, but an inspection shewed that the creek below the bund B was still a capacious and deep trough. There was every probability that if the bund B was breached, and an endeavour was made to restore the state of things that existed in the season of 1884, that the water in the creek would make new surface slopes for itself; that the water-level in front of Wali Canal would be abnormally low. This may be best explained by *fig. 2*. With bund B, the slope backward from tail of creek is probably not more than 6 inches per mile, and the slope of surface of water from head of creek is not more than 4 inches per mile. In the length of 13 miles, with an average fall of 12 inches

per mile, the difference in water levels at B would be 7·5 feet. With the removal of the bund there would be a re-adjustment of slopes by scouring out above and some silting below. It would be impossible to calculate or even guess at the extent of the re-adjustment. The upper reach would certainly have the steeper surface slope, and the supply in Wali Canal would suffer accordingly.

The risk last year was due to the uncontrollable amount of water entering the creek by its own mouth and by spills. The plan adopted was to give the Shah Canal a new head H G, because its bed level did not suit those of the Wali Canal. The new head for the Shah Canal cuts off the inland spills. The remaining spills and the old head of the creek have been closed by the bund E G. A new head D E F has been given to the creek. The Wali Canal has been cleared to the grading of 1884 and a cunette dug through creek on a slope of 1 in 5,000 to perennial branch D.

The creek has an area of about 500 acres, and in the shallows outside the cunette there will be plenty of room for silt. Over 21,000,000 cubic feet of water will be required to raise the water level one foot. As the draw on D E F is expected to be very great into this basin, the bed width of the cut D F has been made only 30 feet, though that of the Wali Canal is 40 feet. Even in the highest floods the basin or creek will fill so slowly that there is no probability of any strain being put on bunds A and B again.

The erosion from one to two miles above D shews signs of having died out. If such is the case, the Wali Canal should be well off for some years to come.

E. A. S.

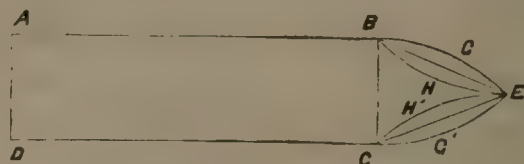
KOREISHI: *March 11, 1888.*

PROPERTIES OF FLUIDS.

BY A. EWBANK.

XII.

fig. 33.



In *fig. 33* let A B C D be a horizontal section of a ship, and let us supply it with a bow of the shape of B H E H' C, of which the parts B H E, C H' E are concave to the water. Then the figure shews that we might substitute another bow where B E and C E are straight lines. This latter would give more space inside and yet use less material in wood or other substances. A third bow such as B G E G' C might therefore be employed, giving more space inside than the straight line bow and not using more material than did the concave-line bow. As a ship is built to carry cargo and must also find room for the crew, it follows that the convex-bow would be more economical.

A second additional reason for preferring a convex-bow is as follows:

If the vessel pitches, that is if its bow dips into the sea, there is with a convex-bow a greater displacement of water than with a concave-bow. Therefore, there will be a greater resistance to this pitching; or, in other words, the vessel, as regards its front part, will be more buoyant. As water breaking over the vessel may do damage of various kinds to the crew, the fittings, the food stored or the cargo—even supposing the risk of foundering to be excluded—it is one object of the builder to minimise this shipping of water.

INUNDATION CANALS.

Fig. 1.

Scale 1"=1 Mile roughly

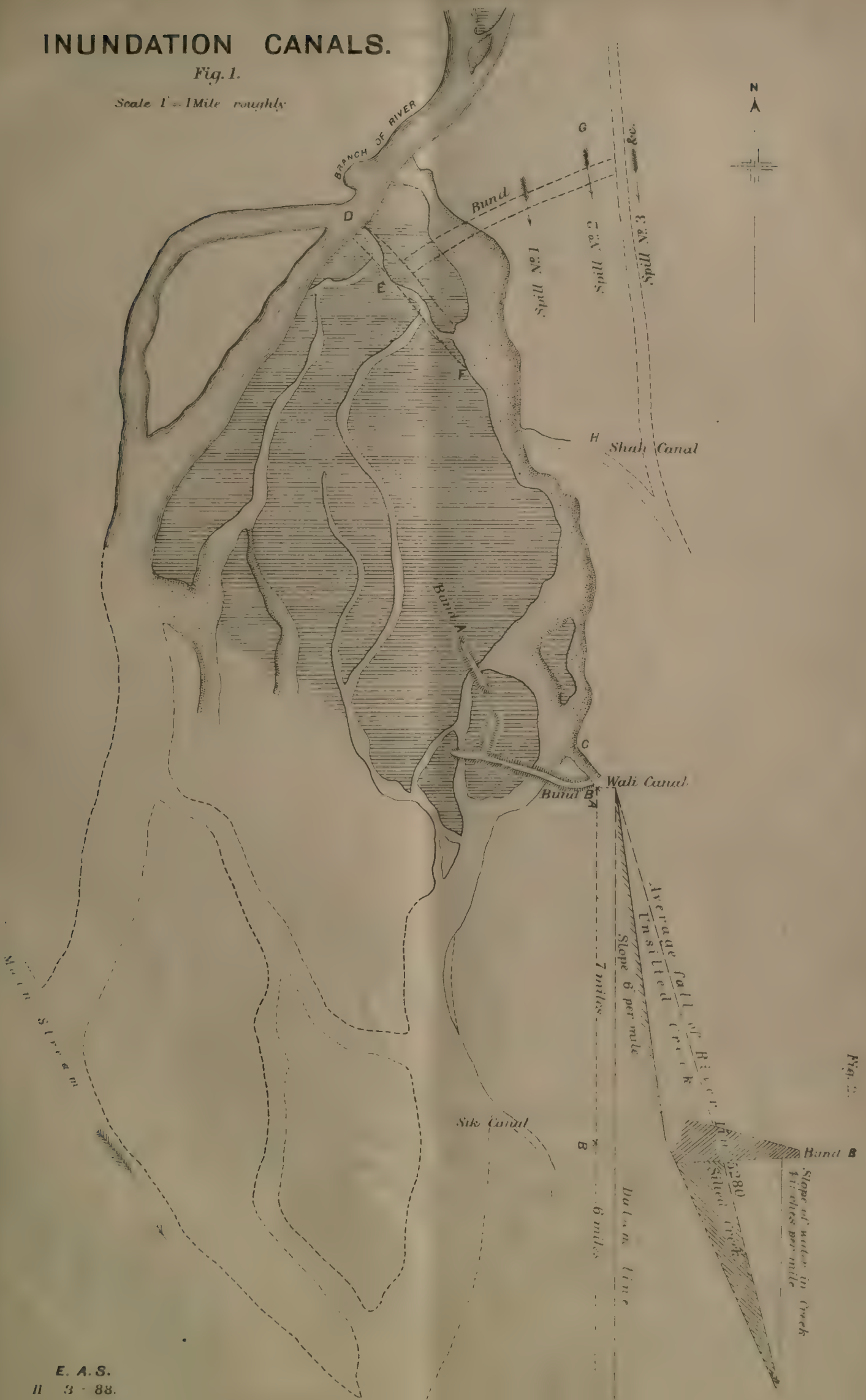
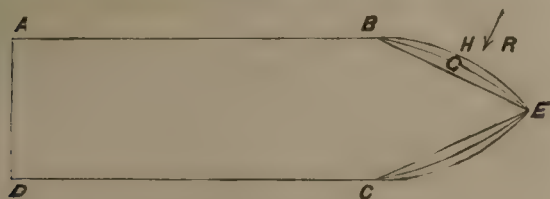
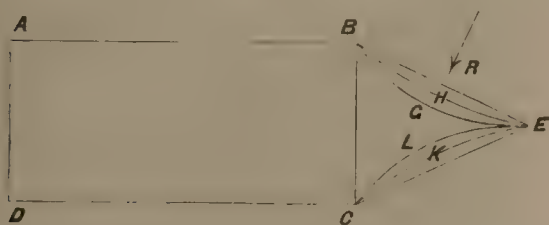


fig. 34.



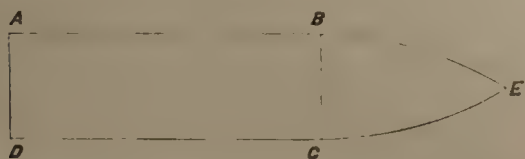
A third reason for making the line B H E (see. fig. 34) convex is as follows. The sea being occasionally rough, heavy masses of water are flung against the bow. If the convex line B H E is struck by a wave coming in the direction R, the blow from this wave tends to crush in the bow and thus to make the line B H E change to a less convex line B G E. As B G E is less in length than B H E the timbers of the vessel are brought closer together. Thus the resistance of each individual timber to compression is utilised to keep the bow unbroken and also to preserve it water-tight.

fig. 35.



If, as in fig. 35, the bow shews concave lines B H E, C K E to the waves, a blow R tends to change the concave line B H E into the still more concave line B G E. Here the timbers tend to separate from each other. A tensional strain is therefore thrown exclusively on the ties or connectors or cementing material instead of a compressing strain on the ties *plus* a similar strain on the material of each plank. The timbers tend to separate and so the bow tends to become leaky.

fig. 36.

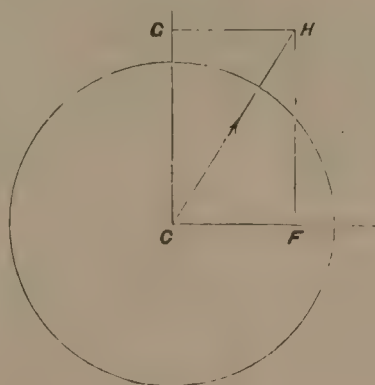


In view of all these considerations, to which others might be added, we see that a vessel should have its bow somewhat as is shewn in fig. 36, where the lines B E, C E are slightly convex. With this figure there are no hollows where the waves that meet B E may lodge. They pass therefore more readily on to A or D, and there by a corresponding tapering end, not shewn in the figure, they are helped to reunite behind the vessel and so to supply at the stern of the vessel as great a forward pressure as possible. The shape however at the stern is not made a duplicate of that at the bow, partly because the rudder is fixed at the stern and partly for other reasons.

In fig. 15 we have a horizontal section of a cylindrical vessel floating partly immersed with its axis vertical. If a horizontal wind acts on the cylinder it will be urged through the water. The direction of the motion will be the same as that of the real force that acts on the cylinder. This real force may not however be the same in direction as that in which the wind is blowing. These directions will however be the same if the floating cylinder has no other body placed upon it. Or the directions would be the same if the cylinder was provided with a mast and sail and the plane of the sail was normal to the direction of the wind. The two directions would not be the same if this sail was "trimmed," that is, if its plane was oblique to the direction of the wind. To this point we shall recur subsequently.

For the present we have only to insist upon the fact that when we have ascertained for a cylinder floating with its axis vertical the real direction of the force that acts upon it, we shall have the cylinder moving through the water in that same direction. With an ordinary vessel this might not be the case. Thus for an ordinary vessel—as we shall presently discover—the wind may blow in one direction, the real force on the vessel may be felt in a second direction, and the real motion of the vessel may take place in a third direction. For our cylindrical vessel we say that the last two directions will coincide, but we say nothing at present regarding the first direction.

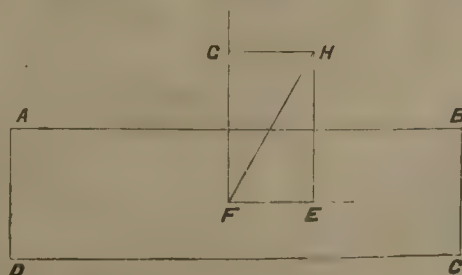
fig. 37.



In fig. 37 let the real force acting on the cylinder be denoted by the line C H. For example, let this force C H be numerically represented by 5. Let the force C H be replaced by components C F and C G and let these be 3 and 4 respectively. Then under the action of the real force the cylinder will move in the direction C H. If C F alone acted the cylinder would move truly in the direction C F. If C G alone acted the cylinder would move exactly in the direction C G. The velocity of the motion along C H, as caused by the total force, would exceed either of the motions along C F or C G as caused by the components acting separately. We cannot however assert that the separate velocities along the directions C H, C F, C G, are exactly proportional to the numbers 5, 3, 4 respectively. For when a body moves through water a resistance is called into play. Let a force P act on a vessel and cause a velocity v and a water resistance R. If we double P we cannot be sure that either v or R will be doubled. Thus in fig. 37 we limit ourselves to the assertion that the velocity caused by the force C H will be greater in some unknown ratio than the velocity, in a different direction, caused by the force C G. Similarly this latter velocity will exceed that caused by the force C F.

We are here supposing the cylinder to be initially floating in still water. Since the velocity is independent of the direction, and is dependent only on the intensity of the force, we may say that in fig. 37 the forces C F, C G, C H act equally profitably. If the force C G produced in its own direction a velocity less than, or merely equal to that produced by C F in its direction, then we should say that the C G force was exerted less profitably than was the C F force.

fig. 38.



Now let us consider the case of a plank of wood A B C D floating. The figure 38 shews the length and breadth of the plank, but not the thickness. Let the length A B be considerable compared with the breadth A D. Let the real force due to the wind—whose actual direction is not considered—be denoted by E H. Suppose this force to be represented by 5, and let its rectangular components E F, E G be 3 and 4 respectively. Let E F be in the direction of the length of the plank and E G accordingly in the direction of the breadth. Then E G acting alone would drive the plank laterally or "broadside on" with a certain velocity y . The force E F acting alone might cause in its own direction a certain velocity x . E G is greater than E F, but it does not follow that y will be greater than x . On the contrary it will often happen that x is greater than y . Here then we say that the force E G is exerted less profitably than is the force E F. If E F or E G alone act, it is certain that the plank will move parallel to A B or D A respectively. In each of these two cases the direction of the motion is the direction of the force. But if the force E H act, it is by no means certain that the plank will move in the E H direction.

ON THE CONSTRUCTION OF SEWERS IN MADRAS.

BY HORMUSJI NOWROJI, B.C.E.,

Assistant Engineer, Madras Drainage Works.

IV.

Invert Blocks for Brick Sewer.—Much difficulty was encountered in the beginning in constructing the bottom portion of the sewer in brickwork, owing to the heavy springs forcing through the bottom of the trench. The idea of having invert blocks for the bottom of the sewer was apparent. But stoneware invert blocks of English manufacture are expensive. Attempts were made to construct the sewers with brick blocks, manufactured above ground. But this proved futile—much care was necessary in obtaining the proper curve and true joints, as the blocks consisted of two rings. The work was slow. They had to be manufactured in short lengths. When longer lengths were attempted they broke on moving them.

It then struck the writer that concrete blocks could be manufactured. These were tried and answered very satisfactorily. The advantages of concrete blocks consist in the ease and rapidity with which they can be manufactured and moulded to any shape and size. The ultimate section adopted for the concrete blocks had the decided advantage of solidity and stability over the segmental form to which alone the brick blocks could be worked to.

The blocks were manufactured in boxes or moulds each capable of containing six. The internal shape of the box corresponds with the shape of the blocks. The moulds consist of a bottom and two sides, the requisite number of partitions are made by cross planks. The sides of the moulds are kept in position by iron straps which are held together by iron bolts passing through the partition planks. The straps are hinged to the bottom of the moulds, so that when the bolts are drawn, the straps fall over, and so do the sides leaving the blocks intact at the sides, but resting on the bottoms from which they can be easily slid off to the ground.

The blocks were manufactured of concrete consisting of—

- 6 parts of gravel
- 3 parts of sand
- 1 part of cement.

Concrete was well rammed down, as it was laid in the boxes. After 48 hours, the sides of the moulds were removed and the blocks left standing on the bottoms of the mould. A week after manufacture, the blocks were sufficiently hard to be removed from the bottoms with-

out injury. They, however, were not used until they were a fortnight old. The blocks were kept constantly wet.

The contents of each block is 4 cubic feet, and the weight 550lbs. or 138lbs. per cubic foot. Each block, two feet long, cost Rs. 1-8.

The blocks were lowered into the trench by means of a derrick. The blocks being 9 inches deep, their skewbacks were clear of the springs at the sides, which allowed the brickwork to be proceeded with without any difficulty. The chief thing to be attended to in these blocks was the joints. It was feared that these blocks being very heavy, any difference in the solidity of the foundations might cause the blocks to sink unevenly and produce cracks at their joints. This was carefully guarded against by packing the concrete well under and at the sides. The springs rising between the joints of the blocks are apt to wash away the cement filling. To avoid this, the joints were first filled with well tarred hemp to a depth of two inches. This prevented water rising between the joints which were afterwards filled to their remaining depth with cement.

Brickwork.—The remaining portion of the invert of the sewer, as well as the covering arch, consists of two concentric rings of bricks giving a thickness of 10 inches, laid in cement mortar of the proportion of 3 of sand and 1 of cement. Gauged bricks made especially for sewer work were used for the whole barrel of the drain in the beginning, but the supply not being commensurate with the demand, it was arranged to build only the bottom half with such brick, and the top half with the best available ordinary bricks. Sewer No. 3, which rises from a higher level than the other sewers, is constructed with brickwork in soorkee mortar of excellent hydraulic properties. In dismantling a cross wall in the sewer, six months after construction, it was observed that the mortar had attained a greater hardness than the bricks—a fact that fully justified its use in construction that is not very deep below subsoil water level.

Plastering.—The inside of the sewers, man-holes and ventilator chambers are plastered with two coats of cement. The first coat consists of 3 of sand and 1 of cement. The second coat is a rendering of neat cement.

The outside of the top half of the sewer arch, as well as of the man-holes and ventilator chambers, are rough plastered with one coat of cement consisting of 3 of sand and 1 of cement.

Pipe Sewer.—Pipes used are of glazed stoneware obtained from Messrs. Burn & Co., of Calcutta and Howrah. They are each 2 feet long exclusive of the socket.

Size of pipe.	Thickness of pipe.	Cost per foot.	
		Rs.	A. P.
6" diameter ...	$\frac{5}{8}$ "	0	5 0
12" do. ...	1"	1	8 0
18" do. ...	$1\frac{1}{2}$ "	3	6 0

Concrete is laid at the sides and haunches, as for a masonry drain.

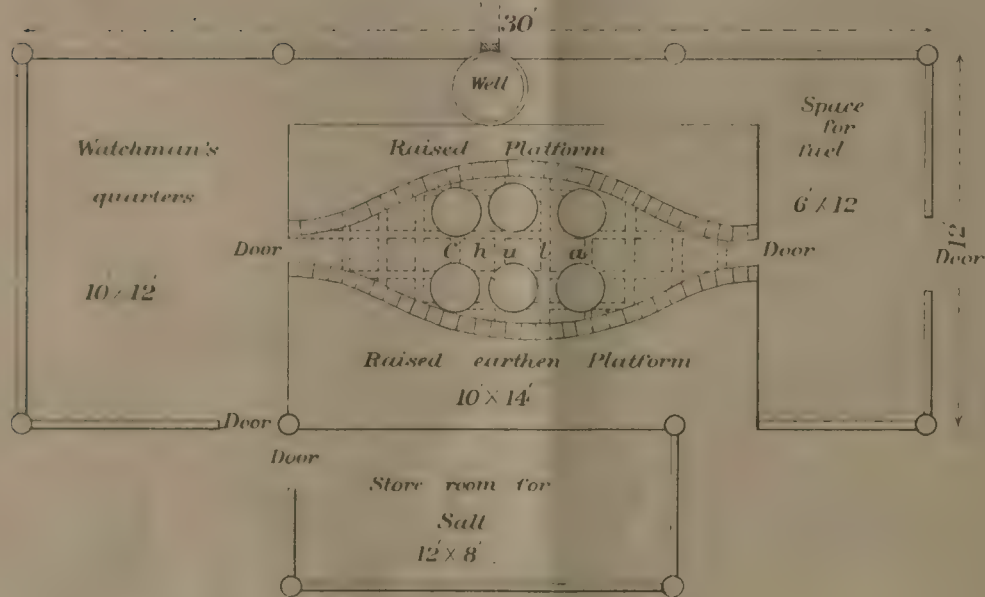
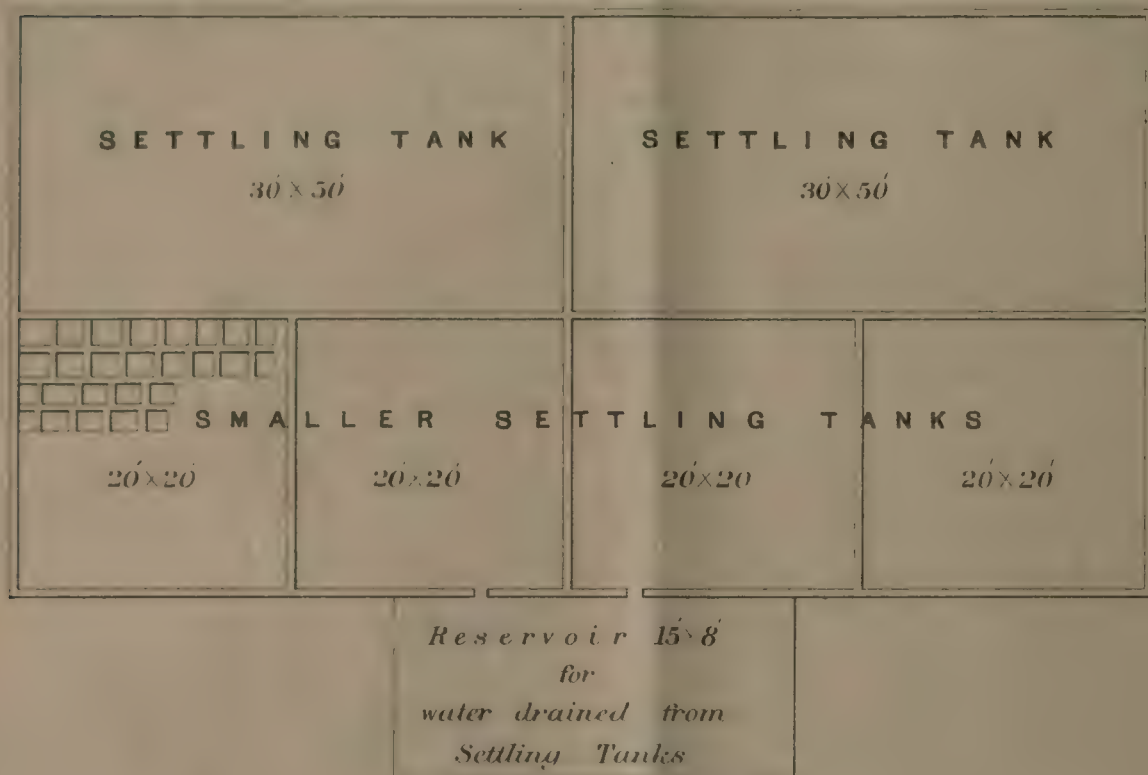
The pipes are jointed with mortar of cement and sand in equal proportions. At the commencement a certain quantity of clay was mixed with the mortar. But this was soon discontinued. The pipes being always in wet soil, it was not deemed necessary to add any clay to the mortar.

Refilling.—This operation, though apparently an easy one, required no less care and trouble than the excavation and timbering itself. The trench was filled up and rammed to the height of the lower row of struts above the completed sewer. The bottom struts were then knocked off and

INDIAN ENGINEERING.

SALT WORKS, LOWER BURMA.

Tidal Stream which overflows at Spring tides



PLAN



SECTION

the remaining portion of the trench was filled up as the planks were taken out. The trench was filled up in layers of earth, each two feet deep, each layer being rammed down before the succeeding one was laid. The surface of the trench was kept a foot below the ground level, and filled for a couple of days with water pumped out of the excavation. Where this was inconvenient, water from the hydrants was turned on. This secured almost complete settlement of the refilled soil preventing subsequent settlement and depressions in the road after being made up.

Man-holes—for the purpose of allowing men to enter the sewers to inspect or clean them, when necessary, are constructed at distances of from 150 to 200 feet usually, and at every change in the direction of the sewer. Their dimensions at the bottom differ with the size of the sewers, but they are made large enough to allow a man to work freely inside. The openings of all man-holes at the top are contracted to $2\frac{1}{2}' \times 2'$, the sides being built with a taper, where necessary. Step irons are provided to give access to the invert. The man-holes also serve as ventilating shafts.

Ventilation of Sewers.—In connection with every alternate man-hole, a ventilator is built. They are placed at the sides of the road. There is a departure here from the usual practice of keeping them in the centre of the road. Where roads are paved, the centre of the road would be the proper place for ventilators, as in that position, the gas escaping creates less nuisance than if placed by the side of the street next to the buildings. But with roads metalled with a soft stone-like laterite, the metalling around them gets worn out rapidly, and they stand projecting a few inches above the road level. In this state, they are not only dangerous to vehicles, but are also liable to be broken. The ventilating chamber is connected with the man-hole by a culvert, and is covered over at the road level with a cast-iron grating. The bottom of the chamber acts as a cess-pit to catch the road grit falling through the bars of the gratings.

For the most part the ventilators have openings at the road level, because they are not expected to create any nuisance as, where possible, they are on that side of the roads which has no habitable buildings or which is skirted by open ground. In crowded localities, where ventilators at road level might be a source of nuisance, it is proposed to connect the ventilating chambers by pipes carried up along the walls of buildings and discharge the gas above the level of the surrounding roof. The foul air will thus be dispersed into the atmosphere at a height where it could not be injurious or offensive.

An experiment was tried for deodorising the foul smell arising from the ventilators by wire cages filled with charcoal and placed at the entrances into the ventilator chambers. This experiment tended to show that the foul smell is considerably allayed; but it is doubtful whether this is due to the absorbent power of the charcoal, or to the reduction in the gas passing through the gratings. The charcoal perceptibly diminishes the current of the air through the ventilator, and confines it in the sewer. However, it is intended to test thoroughly the extent of the efficacy of the charcoal interceptors.

(To be continued.)

MANUFACTURE OF SALT IN LOWER BURMA.

It may perhaps be not uninteresting to your readers to know how salt is usually made in Lower Burma by the villagers. I had occasion to take a few levels for a small canal, and in the course of my levelling I came across the famous salt manufacturing place of the district. It was situated on the banks of a tidal creek, which overflowed about a foot at spring tides. Having an hour or two to spare after my day's work, I proceeded to examine these works, and give your readers the

benefit of my examination, with the hope that it may prove of some interest to them. I found that the tidal water was caught and banded off into large settling tanks before it ran off; here it was allowed to remain till most of the sediment subsided, then drained into other smaller tanks, and again allowed to settle. To facilitate subsidence, I found the Burmans used a curious looking instrument, or rather mould, I should call it, with which they stamped the beds of these smaller tanks, and broke the surface up into a number of small squares about 2" a side. I have tried to represent the appearance of one of these beds after being so tapped, in the rough plan attached, but, I fear, it is but a poor attempt; however, these little depressions catching and confining the sediment like so many bug traps, enable the manufacturer to draw off the clear water into a reservoir, excavated for the purpose, and from this a pipe leads the water off to a small well near the *chulas*. This well, or rather hole, is lined with bamboo matting, a sort of filtering medium.

The *chula* is a common brick-in-mud affair about 3' to 4' high in the centre, and with curving walls. It is covered over with iron bars, interlacing at right angles, and the whole pitched with mud, depressions being left on the top to receive the cauldrons, which are from 4 to 6 for each *chula*. The opening at one end of the *chula* is for renewing the fuel, the other to secure a draught, and is opened or shut like the dampers of a kiln; of course, the axis of the *chula* is laid favorably to the prevailing direction of the wind.

An earthen platform, as high as the *chula*, surrounds it, to admit of persons going to and fro on it for the purpose of replenishing the cauldrons, and removing the salt that has already been precipitated. The water is taken from the well by huge ladles, or a small bucket, and being very near the *chula*, the cauldrons are thus kept well supplied. These cauldrons are of cast iron, hemispherical, and from 3' to 4' in diameter at top, with a depth of about 1 foot.

A temporary shed covers the works and is in most instances the home of the manufacturer for the time he is "out." I invariably saw the portion marked "Watchman's" Quarters in plan, occupied by the family. The shed is of bamboos and thatch, costing very little and easily run up in a day. A smaller compartment is added in, to store the salt as it is being manufactured.

The output of each *chula* is, I was told, about 10 lbs. a day per cauldron on it, but I am not sure of this, as the people whom I questioned were rather reserved in their replies; probably they mistook me for a revenue officer, come to see if the salt tax cannot be raised, and were consequently cautious.

The salt turned out is very white, and pure, and will bear comparison with that manufactured in England; the selling price too is very small, being about 3 pice per viss of $3\frac{1}{2}$ lbs. if purchased on the spot, but this rises to double the amount when it reaches the town or market.

The profit to the manufacturers themselves must, however, be very small, for, of all those I saw at this place, and who have been in the trade for ever so many years, not one could be said to be rich or even well-off; in fact, it seemed to me, from appearances, that they just managed to gain their livelihood with but a very little of the earnings to spare.

They were, however, contented and happy—and what Burman is not when he can get 2 annas a day?—and asked me as a favor not to bund up the stream from which they derived their support, as a rumor had reached them that, with the view of securing sufficient water for the canal, Government intended shutting out the tidal water from their stream. I fortunately had the power to assure them to the contrary, and we parted on the best of terms with each other.

The attached rough plan and section of the works may perhaps help to make my letter clearer.

EXOGENS.

ALLEN'S PATENT LEVITATING APPARATUS, AS APPLIED TO RAILWAY ROLLING STOCK, Etc.

THIS invention proposes to levitate the weight of each loaded waggon, say 90 per cent., by means of the upward attraction of electro-magnets on the underside of flanges of a central rail of special construction. The upward attraction of the electro-magnets is communicated to the body of the waggon by a set of cross and longitudinal bars, the latter are placed below the *journals*. As the weight of a waggon bears on the journals and the levitating force is applied upwards below the *journals*, the pressure of the waggon on the side rails is lessened by the amount of the upward attraction of the electro-magnets, which, of course, must not exceed the weight of the waggon—otherwise it will jump. The central rail transmits to the ground the amount of the weight of the waggon "levitated."

Once the electro-magnets are in action, whether the waggon be stationary or in motion, the levitating force may be considered a statical force, entailing little expenditure—like a string supporting a weight.

REMOVAL OF WRECKS.

II.

Explosives expended in breaking up two Snags in the River Attarabanka, Sunderbuns, of Bengal.

1888.	Description of Charges.	Number of shots.	Dynamite lbs.	Gelatine Dynamite lbs.
March 5.	No. 1 Snag. <i>No. 1 Shot.</i> Consisting of India-rubber cloth lined canvas bag containing the charge laid on river bed partly under the Snag, fired at 9 A.M. Result, broke up greater part of Snag, which was afterwards removed, leaving the stump standing ...	1	7	5
	<i>No. 2 Shot.</i> Consisting of an India-rubber cloth bag containing the charge laid on top of stump, fired about 10 A.M., by means of a Bickford time fuse. Result, the stump was broken to pieces and part of it driven several feet into the mud below level of river bed, the pieces lying around were taken out ...	*B 1	5	2
	No. 2 Snag. <i>No. 3 Shot.</i> Consisting of an India-rubber cloth bag containing the charge laid under the Snag, when fired it blew the Snag into small pieces, completely removing and destroying it ...	1	5	5
	Total ...	3	17	12
	* B Bickford time fuse. The other charges were fired by electricity.			

Summary of Explosives expended in breaking up and demolishing of the Flats "Borpetta" and "Byrub," also two Snags in the Sunderbuns of Bengal.

1888.	Description of Charges.	Number of shots.	Dynamite lbs.	Gelatine Dynamite lbs.
Feb. 29	"Borpetta." No. 1 Dynamite ...	...	498	...
to				
March 4	Gelatine Dynamite ...	8	...	500
" 5.	No. 1 Snag. No. 1 Dynamite ...	2	12	7
	Gelatine Dynamite ...	...	...	...
	No. 2 Snag. No. 1 Dynamite ...	1	5	...
	Gelatine Dynamite ...	...	...	5
March 8	"Byrub." No. 1 Dynamite ...	23	485	...
to				
March 13	Gelatine Dynamite ...	...	...	488
	Grand Total ...	34	1,000	1,000

Explosives expended in destroying the wreck of the India General Steam Navigation Co.'s Flat "Byrub" in the Chilli Chandpiegang River, Sunderbuns, of Bengal.

1888.	Description of Charges.	Number of shots.	Dynamite lbs.	Gelatine Dynamite lbs.
March 8.	<i>No. 1 Shot.</i> Three 18 feet lengths of hose tied together, making a charge 52 feet long, laid on deck from stern forward on starboard side, fired at half tide about 10 A.M., broke down the wreck, the whole length of the shot and a few feet beyond ...	1	28	68
	<i>No. 2 Shot.</i> Consisting of three 21 feet lengths of canvas hose tied together, making the charge 62 feet long, laid on deck near the edge, and in continuation of No. 1 shot forward, fired at high water at 11-30 A.M. Result, broke down the wreck for more than full length of charge...	1	34	80
	<i>No. 3 Shot.</i> Consisting of one 21 feet and one 18 feet canvas hose, making a charge 38 feet long, when tied together, laid on the river bed against the bridge forward of No. 2 shot on Starboard side, fired at low water about 5 P.M. Result, the side was cut off, and the whole wreck subsided 1 foot ...	1	20	50
" 9.	<i>No. 4 Shot.</i> Consisting of 7 feet of canvas hose, hung vertically over Port side, about 50 feet from the bow, fired by a Bickford time fuse at low water at 9 A.M. Result, cut a gash through side of wreck from top to bottom ...	*B 1	7	...
	<i>No. 5 Shot.</i> Similar to No. 4 shot, hung amidship on Port side fired by Bickford time fuse at low water about 9-15 A.M. Result, cut a gash through side of wreck from top to bottom ...	*B 1	7	...
	<i>No. 6 Shot.</i> Consisting of a 7 feet canvas hose laid in wreck of native old boat sunk on the stern of wreck of Flat <i>Byrub</i> . Result, cut the boat to pieces ...	*B 1	7	...
	<i>No. 7 Shot.</i> Similar to No. 6 shot, laid vertical over side on Port Quarter, fired by Bickford time fuse. Result, cut a gash through side from top to bottom ...	...	...	...
	<i>No. 8 Shot.</i> Consisting of four 18 feet lengths of canvas hose, sewn into one length of 72 feet laid along the side of bow girder, forming side of Flat commencing about 30 feet from the bow and trailed aft on Port side on river bed, but in contact with the girder, fired by a Bickford time fuse at 6 P.M., about one hour before low water. Result, it cut the side off the whole length of the shot ...	*B 1	38	45
" 10.	<i>No. 9 Shot.</i> Consisting of 60 feet of canvas hose laid on Port side, aft. of No. 8 shot, fired at low water at 8 A.M. by a Bickford time fuse. Result, side cut off the whole length of shot, and pieces of it recovered by the surrounding villagers ...	*B 1	32	38
	<i>No. 10 Shot.</i> Consisting of a 36 feet canvas hose laid on bed of river round the bows in contact with the plates, fired about 2-35 P.M., 1 hour or so after high water. Result, that part of wreck was blown down ...	1	20	45
	<i>No. 11 Shot.</i> Local shot consisting of a canvas bag 3 feet long x 7 inches diameter, placed inside the afterhatch, fired at 4-30 P.M. Result, it swept the sides out, and large quantity of beams, combings, deck planking and other woodwork came floating up, some wholly released, some partly, the villagers had a great scramble and got most all of it ...	1	50	...
" 11.	<i>No. 12 Shot.</i> Consisting of a 6 feet canvas hose hung vertically over a standing plate of the Port side, fired by Bickford time fuse at low water 8-30 A.M. Result, swept the plate away ...	*B 1	6	...
	<i>No. 13 Shot.</i> Similar to No. 12.	...	...	...

1888.	Description of Charges.	Number of Shots.	Dynamite, lbs.	Gelatine Dynamite, lbs.
	No. 14 Shot. Consisting of 58 feet of canvas hose laid on bed of river round and against the Port Quarter, fired by Bickford's time fuse at 9 A.M. (low water). Result, swept away the plating, and released a large quantity of beams, planks and other wood wreckage, which caused great excitement, and a tough scramble amongst the villagers who secured nearly all, but some drifted away beneath the surface of the water ...	*B 1	31	30
	No. 15 Shot. Consisting of an 18 feet canvas hose, and a small 6 feet hose, the latter tied parallel to the 18 feet hose at the igniting end, laid across against the aft bulkhead, fired at high water about 2 P.M. Result, swept the bulkhead away and released a lot of wood wreckage for the villagers ...	1	23	20
	No. 16 Shot. Consisting of a canvas bag 3 feet long and 7 inches diameter. Local charge put under the forehatch against forward bulkhead, fired at half ebb-tide, about 4-30 P.M. Result, swept the bulkhead away and released a large quantity of beams, planks and other wood work, which was speedily cleared away by a crowd of enthusiastic, excited villagers making the whole operation quite lively ...	1	45	
March 12	No. 17 Shot. Consisting of a canvas bag 3 feet long, 7 inches diameter, put under the main hatch and fired by means of two Bickford time fuse at low water, about 8-30 A.M. Result, it blew up and released a great quantity of woodwork, such as beams, planks, combing &c., &c., and removed all ironwork standing near ...	*B 1	25	25
	No. 18 Shot. Consisting of 36 feet length of canvas hose laid from forward trailing aft on Port side, commencing about 30 feet from the bow, fired at high water, about 2 P.M. Result, broke the side plates still further down, and into smaller pieces, so that the villagers recovered parts of them ...	1	19	20
	No. 19 Shot. Consisting of 28 feet length of canvas hose laid 12 feet along Port side, 12 feet along bulkhead, about amidship, fired at 4 P.M. Result, swept the lot to pieces ...	1	28	15
	No. 20 Shot. Consisting of 14 feet length of canvas hose, and one 6 feet hose laid in broken wreck amidship, fired at 6 P.M. Result, swept up about 20 feet of deck and beams and solid block stone barrel of cement ...	1	11	17
„ 13	No. 21 Shot. Consisting of canvas bag 3 feet long x 7 inches diameter placed in one of the forward hatches, fired by Bickford time fuse at 8-30 A.M. about 1 hour before low water. Result, wreck still further swept away ...	*B 1	25	25
	No. 22 Shot. Local charge against a projecting angle fired at 9 A.M. Result, it was swept away ...	*B 1	5	5
	No. 23 Shot. Local charge at junction of forward bulkhead on Port side, fired at 9-30 A.M. Result obstruction swept away ...	*B 1	10	5
	Total ...	23	485	488
	Note * B means when the charge was fired by means of a Bickford time fuse; all other charges were fired by electric platinum wire low tension fuses.			

The instructions issued were: Flat *Byrub* wrecked on 1st June 1886, in Chilli Chund, Piegang River about one mile from Bola point, she lies on East bank with her nearest gunwale about 30 feet from shore and parallel to it, her dimensions are 200 feet x 28 feet x 7 feet. At ebb tide (8 feet tide range) one end just projected above

the water level while the gunwale nearest the shore for its whole length was from 15 to 18 inches under water, at low water this gunwale would have been exposed, the outer gunwale must lie much deeper as it could not be found with soundings, in the cold weather the wreck would be at low water springs about 5 feet out of the water.

Borpetta wrecked in the river Attarabanka early in 1886, and the snag on which *Borpetta* was snagged is near the wreck, the dimensions of the *Borpetta* are the same as the *Byrub*.

At low water there is 3 feet of water over the wreck, close to the bank; in fact, the wreck is beaten down into the bed of river. It will, however, be dangerous for Flats to pass over the bank edge of wreck at low water, because if a Flat scraped the ground, it would be sure to meet with projecting pieces of wreck. Over all other parts of wreck, there is ample depth of water at all states of the tide.

JOHN HARRIS,

Mining Engineer and Dynamite Instructor

to Nobel's Explosives Co., Ltd.,

GLASGOW.

CALCUTTA; March 21, 1888.

NOTES FROM HOME.

(From our own Correspondent.)

At the last meeting of the Society of Engineers a paper was read on the Wimbledon sewerage works by W. Santo Crimp, the Surveyor. The population of the district at the present time was 25,000 and its area 3,200 acres. In the construction of the new sewers concrete tubes have been largely used. Roads now made up under the 150th section of the Public Health Act are provided with duplicate means of drainage and the entire scheme offers a good example of the "separate" system. The axiom "the rainfall to the river and the sewage to the land" is in this instance fully acted upon. The pumping machinery, settling tanks, filter presses and other portions of the work were fully described.

A paper was recently read before the Civil and Mechanical Engineers Society on the "Construction of Theatres" by W. Emden. The author of the paper previously invited the members to visit the New Court Theatre now in course of construction, and of which he is the architect. The paper dealt almost entirely with those features of construction necessary to resist fire and insure the safety of the public. Lighting by electricity was also dealt with, but many examples were cited both in this and other countries where fires were actually attributed to electric lighting, the author pointed out the disadvantage of this mode of lighting in giving no warning of the danger as in the case of gas, and further that Insurance Companies preferred theatres lighted with gas. Mr. Emden spoke favorably of the use of silicate cotton. In the discussion which followed it was stated that unless iron doors were framed and strengthened the usual sheet form of door proved utterly useless in resisting fires.

With respect to lighting theatres by electricity experiments have recently been carried out in Paris by a commission of technical experts under the presidency of the Prefect of Police, and these go to shew that there is no danger whatever of fire arising in theatres lighted with electricity, provided the installation has been properly put in.

The plans for what is now called the "extension" of the Admiralty Offices have lately been on view in one of the rooms of the House of Commons. These plans shew the continuation of the Mall roadway through to Charing Cross. With regard to the architectural features of the design the *Builder* says "there is no particular objection to make to the scheme beyond the negative one that it is merely utilitarian and economical, and has no architectural interest or value of any kind." A great opportunity has been thrown away by mismanagement and a craze for economy, the great party watchword of the day.

An important addition has been made to the Royal Navy by the completion for sea of the new armour plated barbette ship *Benbow*. This ship is the most powerful of the six ironclads of the Admiral class, and was commenced in 1882, so that she has been over 5 years building. She has a dis.

placement of over 10,600 tons and carries two 110-ton guns besides other powerful armaments. Her machinery is of 11,500 H.P. and she attained a speed of 17 knots at her recent trial at the measured mile. The *Bentbow* cost nearly £812,500.

Several carriages of the Midland Railway running between Derby and Manchester have been lighted with electricity on the system of Mr. Timmis, of Westminster; the arrangement consisting of a battery of Union storage cells placed under each carriage. The compartments are lighted with Swan glow lamps, and the lights are controlled from the guard's van. There is a controlling and a working circuit, and should a breakaway occur or a carriage be temporarily detached, the lamps are at once automatically lighted if they are not already alight, and if alight they remain so. The result of the working is stated to be most satisfactory.

Those who have not access to the Transactions of the Institution of Civil Engineers or of the Mechanical Engineers will find in Professor Robinson's book entitled "Hydraulic Power and Hydraulic Machinery" a good deal of information on this particular subject. Mr. Robinson is enabled from his former connection with Elswich to include an excellent description of the Elswich machines. The great hydraulic lift at Hog Island, Bombay, is also described.

The Brighton Beach Hotel, Coney Island, New York, which has been imperilled by encroachments of the sea, has been recently moved bodily 120 feet inland. It was placed on 120 railway cars drawn by six locomotives on sets of parallel rails. The Hotel covers 92,000 square feet, being 400 feet long and it weighs 5,000 tons. It was lifted on to huge timbers which rested on the cars. It is the intention to move the Hotel still further inland.

Experiments have been commenced at Portsmouth to test the relative merits of solid steel *versus* steel faced armour. The expense of these trials is borne by the Government and the competition is confined to English makers, many of whom have sent specimens for the ordeal. The result recorded of the first experiment is stated to be in favor of the compound system of armament.

Iron gives an account of the scheme for lighting the Suez Canal, by which means the navigation of the Canal will be rendered possible during the 24 hours, thus doubling its commercial carrying capacity. After careful investigation of the various systems it was decided to use compressed oil gas and to adopt floating buoys and beacons fixed on standards. These lamps will be of two kinds—leading lights and channel lights; and of three colors—white, red and green; each having a distinct office in the navigation of the Canal. Pintsh's compressed oil gas system is to be adopted, it having given good results where it has been already used in lighting the roads at Port Said.

A pipe line for the conveyance of petroleum between Lima, Ohio and Chicago is now nearly complete. The line is 200 miles long, is constructed of 6-inch or 8-inch pipes and the output will amount to 200,000 barrels a day. The cost of transmission of the oil will, it is said, be 1 per cent. per barrel.

It is stated that a large Russian ironclad, the *Tchesme*, recently launched at Sebastopol and having a displacement of over 10,000 tons, is to have her boilers heated with petroleum.

first of these appliances will remind your readers of their attempts at chemical research, when fireworks and other explosives possessed charms for their juvenile minds. The second invention suggests that fuze is easily ignited by placing it up the barrel of a common pistol, and exploding a cap upon the nipple.

The Academie des Sciences of France is said to have appointed a committee to enquire into the merits of a firedamp indicator, invented by Mr. Jean Molas. It depends for its action upon the ascensional force of gases lighter than air, which makes electrical contacts for the purpose of lighting a small incandescent lamp and ringing a bell in (say) the manager's office. Its use is not likely to become general, as its action is uncertain with mixtures of less than 6 per cent. of gas in air. Very few managers and no workmen would care to be in a mine containing such an explosive mixture, which would probably be ignited before the apparatus gave warning. Inventors of such appliances should recognize the fact that miners require an apparatus able to detect less than 2 per cent. of gas, as higher percentages are readily recognised by the cap or halo formed about and above the flame of an ordinary safety lamp.

Considerable interest is being evinced by the workmen in the new special rules, and objections are being forwarded by them to the Inspectors. In some districts the Executive Council of the Miners Associations have compiled sets of special rules and forwarded them to the workmen, the employers and A. M. Inspectors of Mines for approval. In the majority of cases meetings have been held, or are being arranged to be held, for the discussion and arrangement of the points of difference between the employers, workmen and A. M. Inspectors.

The diamond borehole being prosecuted near Seaton Carew (G. Durham) has now reached a depth of 1,300 feet, the latter 780 feet of which is in magnesia limestone. A brine spring was found at a depth of about 1,150 feet. It is probable, however, that the feeder, like others found in the magnesian limestone, will be reduced in volume and percentage of salt if attempts are made to utilize it. These brine springs are frequently found in the magnesian limestone and coal measure of the North of England, but the salt is usually associated with an equal volume of chloride of lime, which renders it useless for commercial purposes.

The results of the last four or more months of working at the Gwynfynydd Mine in Merionethshire are said to be 628 ounces 7 grains of gold valued at £2,000 from 334 tons of crushed quartz. The yield is therefore about 2 ounces per ton, valued at about £3½ per ton. The results must be somewhat disappointing to the promoters, who announced during December last that they had over 2,500 tons of quartz ready to pass through the mill, and expected to obtain about 1 cwt of gold per month.

It is a somewhat remarkable circumstance that no explosions have occurred during the last four or five months in the collieries of great Britain, when many shots must have been fired in the formation of the additional manholes required by the New Mines Act to be made on certain travelling roads; if coal-dust alone was so dangerous, as its advocates would lead us to believe, many accidents should have occurred during their formation.

MINING IN GREAT BRITAIN.

(From our own Correspondent.)

Four Scotch firms (Messrs. Baird & Co., of Gartsherrie, Messrs. James Bimmo & Co., Messrs. William Black & Co. and Mr. James Gemmell) all of the Slamannan district, have been invited by the Admiralty to tender for lots of 500 tons of steam coals, to be delivered at Portsmouth, in order that their evaporative power may be tested.

Two new inventions for igniting fuze without exposing flame and sparks are being introduced into coal-mines. In one case a small tube is employed containing a mixture of chlorate of potash and sugar and an isolated charge of sulphuric acid, so arranged that when the vessel containing the sulphuric acid is broken or crushed, the flame produced by the chemical re-action will ignite the fuze placed within the end of the tube. The second arrangement consists of a small closed tube which is placed over one end of the fuze, and in which a match can be drawn over a friction surface; a sharp pull of the match produces flame and ignites the fuze. The

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, April 21, 1888.

Upper Burma.

Mr. J. W. L. Tooze, Assistant Engineer, 1st grade, Ruby Mines Division, is granted six months' leave on medical certificate, with effect from the forenoon of the 15th March 1888.

Mr. H. O. Walling, Assistant Engineer, 1st grade, held charge of the Garrison Division, Mandalay, from the 7th to the 21st March 1888 inclusive.

Lower Burma.

Mr. D. K. MacDonald, Sub-Engineer, Mandalay Garrison Division, is promoted to the rank of Honorary Assistant Engineer.

Madras, April 24, 1888.

Mr. J. Traill, Executive Engineer, 3rd grade, is granted leave without allowances for nine months from or after 1st May 1888.

The following posting is ordered :—

Mr. A. M. Hayes, Assistant Engineer, 1st grade, to the II. Circle, Kistna Eastern Division. To join on return from leave.

Punjab, April 26, 1888.

His Honor the Lieutenant-Governor is pleased to sanction the following promotions in the Amalgamated Engineer Establishment of the General and Irrigation Branches of the Public Works Department, Punjab, with effect from the dates noted against each :—

Mr. J. M. Campion, Executive Engineer, 2nd grade, to Executive Engineer, 1st grade, permanent rank, *vice* Mr. W. B. Harrington, retired, with effect from 19th March 1888.

Mr. R. Sadler, Executive Engineer, 2nd grade, sub. *pro tem.*, to Executive Engineer, 2nd grade, permanent rank, *vice* Mr. W. B. Harrington, retired, with effect from 19th March 1888.

Captain H. E. S. Abbott, R.E., Executive Engineer, 3rd grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, permanent rank, *vice* Mr. W. B. Harrington, retired, with effect from 19th March 1888.

Mr. H. C. Granville, Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 4th grade, permanent rank, *vice* Mr. W. B. Harrington, retired, with effect from 19th March 1888.

Mr. R. A. Molloy, Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.*, *vice* Mr. Sadler, promoted permanently, with effect from 19th March 1888.

Mr. W. J. Greer, Executive Engineer, 4th grade, to Executive Engineer, 3rd grade, sub. *pro tem.*, *vice* Captain Abbott, R.E., promoted permanently, with effect from 19th March 1888.

Mr. C. F. Tuffnell, Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, sub. *pro tem.*, *vice* Mr. Granville, promoted permanently, with effect from 19th March 1888.

Central Provinces, April 28, 1888.

Lieutenant J. E. Capper, R.E., Assistant Engineer, 1st grade, temporarily employed in the Military Works Department, and now on furlough, is retransferred to the Central Provinces.

India, April 28, 1888.

Major S. L. Jacob, R.E., Executive Engineer, 1st grade, Punjab, is appointed to officiate as Superintending Engineer, during the absence of Mr. Higham, on furlough, or until further orders.

Captain H. G. Kunhardt, R.E., Executive Engineer, 2nd grade, State Railways, is appointed to Officiate as Manager and Engineer-in-Chief of the Tirhoot State Railway, during the absence of Mr. H. Bell on the furlough granted him in Public Works Department Notification dated 9th March 1888, or until further orders.

Mr. E. J. Rumsby, Executive Engineer, 3rd grade, Central Provinces, is granted special leave for a period of two years under the terms of Public Works Department Resolution dated 3rd October 1887.

Mr. A. J. Oldham, Executive Engineer, 2nd grade, sub. *pro tem.*, State Railways, is granted special leave for two years under the terms of Public Works Department letters dated 3rd October 1887.

Mr. C. E. Gael, Executive Engineer, 1st grade, Central India is permitted to retire from the Service with effect from the 23rd February 1888, the date of the expiration of his special leave.

Assam, April 28, 1888.

Privilege leave for two months and fifteen days is granted to Rai Preonath Banerji Bahadur, Executive Engineer, 3rd grade, and District Engineer, Sylhet, with effect from the forenoon of the 19th April 1888.

With reference to the above, Pandit Matadin Sukul, Rao Sahib, M.A., Assistant Engineer, Sylhet, is appointed to officiate as District Engineer, Sylhet, during the absence on privilege leave of Rai Preonath Banerji Bahadur, District Engineer, Sylhet.

Pandit Matadin Sukul took over charge of the District Engineer's office, Sylhet, on the forenoon of the 18th April 1888.

N.-W. Provinces and Oudh, April 28, 1888.

Irrigation Branch.

In anticipation of the approval of the Government of India, Major F. V. Corbett, R.E., is appointed to the charge of the 2nd Circle Irrigation Works, *vice* Mr. Beresford, reverted to Executive Engineer, 1st grade.

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner, Oudh, is pleased to order the following reversion and promotion, with effect from the dates specified :—

Mr. A. M. Fagan, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, consequent on the return from furlough of Major Corbett, R.E., with effect from 16th April 1888.

Mr. A. M. Fagan, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Tickell, on furlough, with effect from 24th April 1888.

Captain J. Clibborn, S.C., Executive Engineer, 2nd grade, was attached to the office of the Chief Engineer, Irrigation Works, on special duty, from the 6th to 22nd April 1888, inclusive.

Buildings and Roads Branch.

Rae Mohendro Nath Chakarbarti Sahib, Assistant Engineer, 1st grade, is transferred from the Hamirpur to the Hardoi District as District Engineer.

Mr. R. M. Thompson, Sub-Engineer, 3rd grade, temporary rank, is posted to the Basti District as District Engineer.

Bengal, May 2, 1888.

Establishment—General.

Rai Prosonno Coomar Duneary Sahib, Executive Engineer, temporary rank, attached to the Office of the Superintending Engineer, Eastern Circle, is transferred to the Dacca Division.

Establishment—Railway.

Baboo Bihary Lal Mookerjee, Special Deputy Collector, Tirhoot State Railway, is granted 15 days' privilege leave, with effect from the 16th April 1888, or such date as he may avail himself of it.

Establishment—Irrigation.

Rai Raj Kissen Banerjee Sahib, Executive Engineer, is transferred from the Pooree to the Mahanuddy Division.

The Lieutenant-Governor is pleased to make the following promotions and reversions in the Engineer Establishment, with effect from the dates specified :—

Mr. E. R. Gardiner, Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 14th March 1888.

Mr. H. H. Green, Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 14th March 1888.

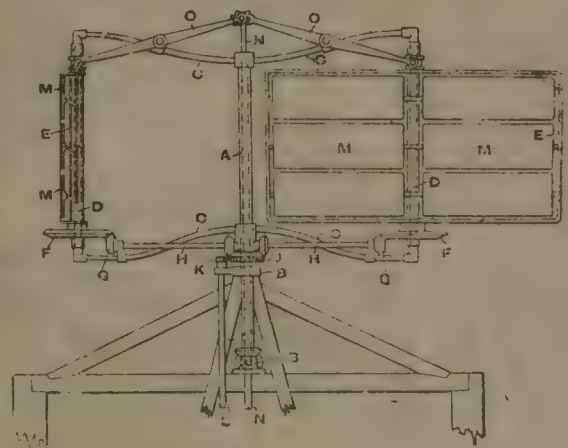
Mr. W. B. Gwyther, Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 2nd April 1888.

Mr. R. E. Carter, Executive Engineer, 4th grade, temporary rank, to revert to Assistant Engineer, 1st grade, with effect from 1st May 1888.

Indian Engineering Patent Register.

RECENT BRITISH PATENTS.

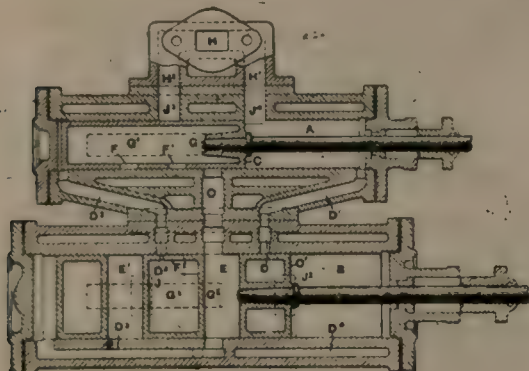
WIND MILLS.—*C. Hawkins, London.*—The object of this invention is to make the sails of a wind mill adjust themselves continuously to receive the force of the wind. Rectangular sails are employed which present their surface in the most favorable way as they revolve round a vertical or horizontal axis. When the sail is moving directly towards the wind the edge is presented to it, and when moving with the wind the surface is at right angles with its direction. In the accompanying illustration one method of carrying out this idea is represented. The hollow vertical axle A is supported in bearings B; the arms C are attached to it in pairs. Across the ends of each pair of arms is fixed the rod D, which ties the arms firmly together, and upon each of these rods is pivoted a rectangular sail E. A toothed bevel wheel F is attached to each sail, and gears with a pinion G on the horizontal shaft H. Another pinion I on the shaft H gears into a wheel J concentric with but loose upon the axle A. This wheel J is the adjusting wheel, and according to the position



in which it is set so will the sails adjust themselves relatively to the wind. On the lower part of J the spur teeth are cast, which gear with a pinion K on the shaft L. The relative sizes of the wheels are arranged so that the sails shall revolve on the rods D through half a revolution and in a contrary direction to the main axle, while the latter turns through a complete revolution. The wheel F is double the diameter of J. Each sail carries hinged louvre boards M, which are opened and closed by the levers O and N in order to regulate the power supplied to the machine. The inventor makes three claims for

the apparatus which effects the continuous adjustment of the sails.—No 2953. February 25th, 1887.

STEAM ENGINES.—C. D. Abel, London. (J. C. Grainer, Kupferhammer, and C. Ruperti, Brackwede, Germany.)—According to this invention, the steam is admitted to both sides of the piston by means of specially constructed passages and ports in the cylinder and piston, and the slide valve arrangement is entirely dispensed with. The application of this method to a compound engine is seen in section in the accompanying drawing. A is the high pressure cylinder, and B the low pressure one. The pistons C¹ are made hollow; C² is provided with a longitudinal slot G¹ and ports F F¹, while C³ is formed with a slot G², port F², and cross passages E E¹. The pistons act as each other's slide valves. In the position of the pistons shown in the drawing, the piston C¹ has still part of its stroke to travel through, while C² is at the commencement of its forward stroke. The steam enters the cylinder B through the port G², and passes through G³ to the interior of the piston C¹. Thence it escapes through F², along the passage D², to the back of the piston C. The exhaust of the steam at the front of the piston C takes place through the passage J⁴, whence it goes along the tube H and enters the piston C through the port G and slot G¹. When the port F¹ comes opposite O, the steam escapes, and



travels across the piston C¹, through the passage E¹, along the pipe D², to the back of the piston C¹. After performing its work there, it escapes to the atmosphere through the ports J¹. When the piston C is at its dead centre position at the right end, the piston C¹ has still a part of its stroke to travel. The steam passes through F² D D¹, and drive C to the left. The same series of operations takes place with respect to the exhaust steam from the back end of the cylinder A as with the steam at the back of the piston, but it comes through J³ H F O¹ E¹ D⁴ J². There are also single cylindered engines described in this specification, whose pistons act as their own slide valves. The steam enters through a port in the cylinder, and passes through a slot into the interior of the piston. There are ports at each end of the piston, and the ends of the cylindrical part of the cylinders are broadened, so as to allow the steam to escape through the ports to the back of the piston. The exhaust also takes place through a port in the side of the cylinder. Six claims are made—No. 6238. April 28th, 1887.

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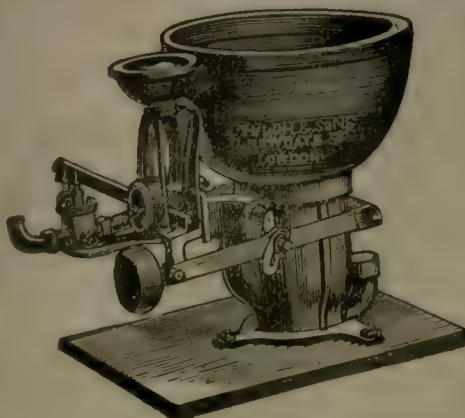
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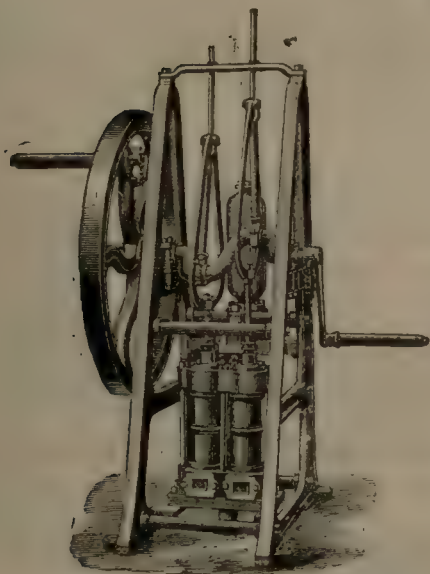
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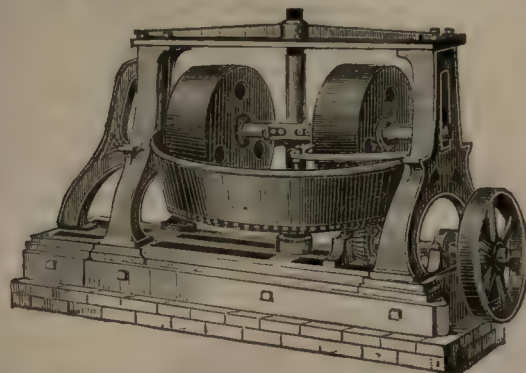
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AND

In the matter of the Deoghur Mining Company, Ltd.

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DIGNAM, ROBINSON & SPARKES,

Attorneys for the Liquidator

of the abovenamed Company.

4, STRAND, CALCUTTA ;
24th April 1888. }

NOTICE.

Bengal-Nagpur Railway.

1st. Sealed tenders for the supply of 30,000 cubic feet of oakwood scantlings required for the construction of Broad Gauge Railway Carriages in the Nagpur Workshops, B.-N. Railway, will be received by the Agent up to noon of the 30th May and will be opened by him then and there in the presence of all parties who may choose to attend.

2nd. The timber to be seasoned and sound, cut perfectly straight and square to be free from knots, flaws or cracks. Sizes of scantlings, and terms and conditions of tender along with form of tender may be obtained from Locomotive and Carriage Superintendent, B.-N. Railway, Nagpur.

3rd. Seals of tenderers unable to write will not be accepted; they should have their marks verified by witnesses.

4th. Covers to be superscribed "Tender for Teakwood scantlings for Bengal-Nagpur Railway."

5th. The tender may be in part or for whole requirement, and the Agent reserves to himself the right to accept in whole or in part, but in the event of his accepting in part only; and the tenderer failing to take up the contract, the whole earnest deposit will be confiscated.

6th. Tenders without earnest money of Rs. 1,000 will not be attended to.

7th. The Agent reserves to himself the power of rejecting any tender without assigning a reason, and does not bind himself to accept the lowest or any tender.

NAGPUR ;
9th April 1888. }

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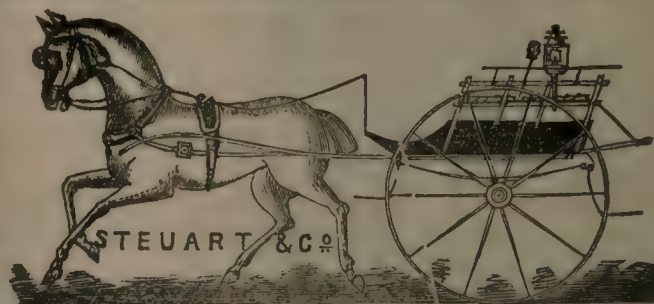
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Obituary.

DODSWORTH—17th April at Rangoon, Burma, A. T. Dodsworth
Executive Engineer, P. D. W.

INDIAN ENGINEERING.

SATURDAY, MAY 12, 1888.

MUNICIPAL OFFICES, BOMBAY.

WE would like to congratulate the Corporation of Bombay on having at last decided the question of the new Municipal Offices, but the scheme has been so often altered, and the clock so frequently put back, we fear even now to be premature. The healthy sign about the last Resolution lies in the fact that it is a return to the "old love," which in our opinion should never have been forsaken. Of course in all Municipal deliberations on the subject of buildings, there will be two parties, the economical party and the liberal party; or those on the one hand who wish to have a mere brick-kiln with holes in it, and those on the other who wish to make their offices an exponent of Municipal wealth. The Corporation of Bombay have been in no way different from Corporations in other parts of the world, and it is the contentions of these two factions which has so long delayed the commencement of the new offices.

Mr Chisholm's designs for the Bori Bunder site, on which the foundation stone is actually laid, were accepted so long ago as January 1885, but in an evil moment the whole scheme was abandoned for an entirely new site on the plot of ground known as The Oval, opposite the "Sailor's Home," the liberal party probably anticipating that Government would not permit any building to be erected in so prominent a position which was not as elaborate and ornate as the other public buildings of Bombay. The utilitarian party then had an innings and scored in getting the Corporation to pass a resolution that notwithstanding the change of site, the original sum of five lakhs was not to be exceeded; accordingly when Mr. Chisholm submitted an amended design for the new site, the Government returned it, with remarks to the effect that the architect was capable, but the sum placed at his disposal insufficient.

The liberal party then scored by inducing the Corporation to pass a resolution that Mr. Chisholm should be requested to submit a complete design without any limit of cost, a portion of which could be at once constructed for a sum not exceeding five lakhs of rupees. Thus the "Pull devil pull baker" ended in a position which pleased everyone! The liberal party saw the Corporation committed to a magnificently ornate structure, the economical party were satisfied that they would not go beyond their five lakhs of rupees, and the architect conjured up visions of loveliness with fees at the points of distance! But alas, to quote the words of Sergeant Buzfuz, "the mine was preparing, the sapper and miner were at work," and before the architect had put pencil to paper, the Chariman of the Corporation (the sapper) and the Government architect (the miner) upset the whole of the proceedings by introducing an entirely new proposal, viz., to convert the Cathedral Schools—a building the Government apparently wished to get rid of—into Municipal Offices by adding to them. This scheme was referred to a select committee who

disapproved of it entirely, but got itself into trouble with some members of the Corporation for daring to make suggestions after dealing with the subject referred to it.

Anyone who has taken the trouble to follow the facts will now see, that if the dry bones of Municipal Proceedings interested the public generally, the position was sensationally perfect, for no move could be made in any direction. Fortunately, under a new Chairman a glimmer of light was shed on the proceedings when he did what every sensible man outside the Corporation would have done long ago, and restored the whole thing to the position it occupied before any change of site was mooted, and this glimmer has strengthened into the perfect light of day by the admirable resolutions which the Commissioner proposes to lay before the Corporation at their next meeting.

A good deal of capital has been made out of cubical estimating. No doubt this method of estimating is exceedingly useful, but it is at the best a very rough method, and he would be a bold man who commenced work without an accurate estimate based on quantities. It certainly is not a fact that buildings in Bombay cannot be erected for less than six annas per foot, for the new Press Building, the most recent structure erected by Government, has actually been constructed for about $4\frac{1}{2}$ annas per cubic foot enclosed. Why should not Mr. Chisholm's designs be carried out at this rate? Not that we would recommend this at all. We think that the sum to be spent should be sufficiently liberal to insure sound construction, and the employment of the most durable materials. These should be intelligently and artistically put together, but all useless features and all hewing and hacking of stone for the exposition of wealth and it may be the glory of the architect, should be ruthlessly excluded. To pinch an architect so as to compel him to cut down thicknesses, and adopt generally the lowest factors of safety, is a most unwise proceeding. State the accommodation you require and your architect will tell you what it will cost exclusive of ornamentation. If this be too much, it is far wiser to reduce the accommodation than to make the architect run risks.

The sum of money which the Commissioner proposes to ask for is adequate, and ought to produce a sound and substantial building of a kind that no city need be ashamed of, but it is happily insufficient to provide for what Pugin aptly terms "constructed ornamentation."

THE SIND-SAGUR STATE RAILWAY.

THE Bhukkur-Malickwal Section of the Sind-Sagur State Railway was opened for every description of traffic on the 1st August 1887; thus completing one of the frontier protective Railways, as the section from the Chenab River near Sher Shah to Bhukkur was opened for traffic on the 1st January 1887.

This line leaves the North-Western Railway System at Mooltan, crossing the River Chenab by a steam ferry near Mozuffergurh, some 12 miles to the west. From here it runs parallel to the River Indus in a northerly direction past Leiah, Bhukkur and Koondian, from which station it takes an easterly course along the foot of the Salt Range

past Khushab, then follows the northern banks of the River Jhelam past Pind Dadan Khan until it reaches Haranpur, near which point the line is carried over the river by the recently completed Victoria Bridge, and is continued due east until it joins the North-Western Railway at Lala Musa, a station between Jhelam and Wazirabad.

The "Eastern Section," from Lala Musa to Malickwal, is 43 miles long, and was recently converted from the metre to the broad gauge; the "Western Section," the last length of which has just been opened, is 295 miles long, or, including all its branches, 336 miles. There are four branches, *viz.*: from Haranpur to the Mayo Salt Mines at Khewra; from Koondian to Mianwali; from Bhukkur to the bank of the River Indus, opposite Dera Ismail Khan; and from Mahmood Kote to the bank of the River Indus, opposite Dera Ghazi Khan, all of which are also now open for traffic.

The works are generally rather light, but the first 60 or 80 miles at each end of the Western Section are somewhat heavy, with a considerable number of bridges over hill streams and inundation canals; the centre part from Khushab to Bhukkur being mostly through a sandy desert.

The line is on the broad or $5\frac{1}{2}$ feet gauge, and laid throughout with permanent-way of flat footed steel rails weighing 75lbs. to the yard mostly on steel transverse sleepers; some short lengths where the salt in the soil is excessive have transverse wood sleepers instead of steel.

The first surveys were taken in hand in November 1884, the earthwork was commenced in 1885, and the line was opened in August 1887, that is, in about $2\frac{1}{4}$ years from the first orders for the survey, or in rather less than 2 years after the first sod was turned.

The Victoria Bridge over the River Jhelam is a little more than half a mile long, being of 17 spans of 150 feet girders, spaced 160 feet from centre to centre of the piers.

The foundations are on single wells, 25 feet in diameter, built on wrought-iron curbs $26\frac{3}{4}$ feet in diameter, and sunk 120 feet below the rail level, or 82 feet below low water level.

The brick stiening is $5\frac{1}{4}$ feet thick, and all the wells are hearted with semi-hydraulic lime concrete. The wells from low water level are carried up to girder bed level in solid brick work as circular piers 25 feet in diameter finished off with plain massive cap projections, the bottom of the girders being 10 feet above high flood level.

The girders are of steel and iron 160 feet long. They are of the ordinary triangulated type with the roadway on the bottom flange, and the cross girders have been lengthened out on both sides to carry a footway 5 feet wide outside each main girder. Each span complete weighs 175 tons.

The sinking of the well piers was commenced in September 1885, and was finished in December 1886.

The first delivery of girder work at Bridge site was in November 1886, and the last girders were erected under considerable difficulties, owing to floods, on the 29th April 1887, the bridge being opened for traffic on the

morning of the 16th May 1887, the whole structure having been completed in 20 months from start to finish.

The estimate for this bridge, and the somewhat extensive protective banks formed of large boulders up-stream to steady the river through the bridge, as well as the buildings and offices connected with it, amounted to Rs. 25,70,000, but the actual cost is Rs. 19,00,000.

The total cost of the Western Section including this bridge was estimated at Rs. 2,37,32,186, or at the rate of Rs. 70,632 per mile complete in all respects, including rolling stock and steamers for the steam ferries.

The actual cost of the line complete is about Rs. 2,27,32,000, which at the present rate of exchange amounts to £1,610,196 sterling, giving a rate for 336 miles of Rs. 67,768 and £4,792 per mile.

The Inspecting Engineers expressed themselves very highly satisfied with the substantial manner in which the whole of the works on this Railway have been executed, and the neat and the pleasing style in which the stations, engine sheds and houses for the accommodation of the staff have been finished.

The Government of India have thanked Mr. James Ramsay, M. Inst. C.E., the Engineer in Chief, and his Engineering staff, for the satisfactory and economical manner in which the whole of this Railway has been completed.

By the opening of this Railway and its branches, the Viceroy was lately able to visit with ease and comfort two of the important frontier military stations west of the Indus, Dera Ghazi Khan and Dera Ismail Khan, where *durbars* for native chiefs were held, and he saw representatives of some of the wild tribes on the frontier.

He also visited the Mayo Salt Mines, and was much interested with all he saw there.

BROAD OR METRE GAUGE ?

THE latest addition to the literature of the relative merits of Broad and Metre Gauge lines of Railways for India is furnished by a selection of printed papers from the records of the Public Works Department under the Government of India. The subject has been treated exhaustively from all points of view, and may be said to have been set at rest once and for all. It seems to be a fashion among professionals to range themselves into two camps, and to advocate one gauge or the other 'for choice' as the phrase goes, rather than consider the necessities of each case. The battle between these two bodies of men—each composed of able, honest and conscientious members of the service—has raged so long and with such doubtful results that we are glad the matter is about to be settled by an authoritative decision more in accordance with sober reason, than from the dictates of prejudice. In such circumstances experience is the safest guide instead of ability or position in the service. And this is amply borne out by the document before us. In order, however, to understand the true meaning of the controversy, we must go back some years in point of time, and mark when the change in the gauges was brought about. Lord Dalhousie, in his Minute of the 4th July 1850,

pointed out the evils of permitting the introduction of two gauges in India, as had been done in the United Kingdom; and strongly advised the Government of India in the future to rigidly enforce uniformity in that direction. In selecting it care must be taken to determine that which science and experience would select as the best suited to the circumstances of the country. After a good deal of discussion a gauge of 5 feet 6 inches was adopted and continued up to the end of 1863, when a deviation was made in the case of the Nalhati Railway, which was opened in December of that year. Three years previously Government awoke to the fact that the guaranteed system of constructing railways in India had led to extravagance and waste, and when it was necessary to extend the railway system it should be done on a cheaper scale. While advocating economy it was at the same time the intention of Government to make these temporary lines as a make-shift expedient, that would not be allowed to develop into a separate system, nor to permit them to compete with the lines on the standard gauge. The history of the metre gauge lies in a nut-shell, as the following important communication addressed by the Government of India to Mr. J. E. Wilson, Agent for the Indian Branch Railway Company, dated 29th December 1862 will shew :—"The first point that calls for remark is the gauge to which you make no special allusion His Excellency in Council is of opinion, that it will be essential to insist on the adoption of the standard Indian 5 feet 6 inches in the case of all railways that are intended to form portions of main lines. But when the lines proposed are designed as *bond fide* tramways, that is, feeders to the main system, but not essential parts of it, and when the expected traffic may not warrant the outlay necessary for the formation of a full gauge line, the Government of India will sanction, as it has already done in the case of the Nalhati line, narrow gauge light lines as a temporary expedient on the conviction that such lines will be replaced by full gauge lines of a more substantial character whenever the development of the traffic renders such a change advisable. Where such narrow gauge lines are sanctioned, it will therefore be an advantage that they should be of the lightest and most economical description compatible with the safety and necessary degree of permanence, in order that there may be the least possible difficulty in the way of the change when it has become expedient, and that there may be no doubt as to their temporary and provisional character, and no risk of their being permitted to grow into a system which would compete with the system constructed on the standard or national gauge." A year and a half later, to still more emphasize their meaning, the Government of India in a letter to the Government of Madras lays special stress on this point, and urges on its attention "that narrow gauge lines of a really substantial character should not be encouraged." In a word, the metre gauge was permitted only on sufferance, and when there was no help for it. But within three short years a change seems to have come over the spirit of the dreams of the 'powers that be,' and in 1867 it was proposed to admit permanent

narrow gauge lines, but under certain restrictions. As financial pressure began to be seriously felt by the authorities, reserve was thrown aside, and in 1869 permanent narrow gauge came to be recognised as *the* thing even for main lines. In that year the Government of India addressing the Secretary of State recommended that when the prospects of the returns from any contemplated system of lines are not satisfactory, it would be left an open question whether such lines may not be constructed on a new gauge instead of the ordinary broad Indian gauge. The Government of India was induced to adopt a different opinion within such a short time, from a belief that the broad gauge line was a wasteful machinery, and the narrow metre gauge was sufficient for the needs of the country. That their views were shared in by the authorities at home, is apparent from a paper read by Mr. W. T. Thornton, Secretary of the Public Works Department, India Office. He was bold enough to say that 'it could not be argued that the transport of the largest amount of traffic to be expected on any of the contemplated lines would be beyond the capacity of the metre gauge. It would be worse than useless to go through all the arguments employed by him, but it is amusing to find him arriving at the following conclusion: "If the traffic," says Mr. Thornton, "were anything like what it was originally expected to be, were of anything like the amount for which the lines were designed, and on which the original shareholders fondly reckoned, they would surely be yielding much more nearly ten per cent. than 5 per cent. on the cost. What they are on an average really yielding is, however, three per cent., whence it may be safely inferred that their present traffic is certainly not three-fifths, and is probably not three-tenths of what, with their actual standard gauge, they could carry: nor therefore more, if indeed nearly so much as they could carry, if their gauge were less by two-fifths than the standard gauge. But if this narrower gauge would suffice for the traffic of the existing guaranteed lines, of course it would be more than sufficient for that of the projected State lines, which, in a commercial sense, are so much less promising." Now, it should be borne in mind that the real point at issue is the amount of traffic that might be ultimately expected on Indian Railways. The want of information on the subject is so general among officials, that we do not wonder they took such a pessimistic view of the whole business. When in their infinite wisdom the *fiat* went forth that metre gauge railways were the best suited to the requirements of the country they had very little idea of the extraordinary traffic that would be the outcome of the proper working of the railways, and the conditions they would satisfy. We have already exceeded the limits we had proposed to devote to this article, and hope to resume the subject in a future issue; but before taking leave of it we would cite one instance in support of our position, *viz.*, that the Government officials had mis-calculated the traffic on a single line—the Indus Valley Railway—in spite of the fact that for three years together they had been in possession of facts and statistics from which better results might have

been anticipated. From Colonel Strachey down to Captain Williams, everyone seems to have been deeply impressed with the utter inutility of that line, which, it was deliberately prophesied, would be a veritable 'White Elephant' on the hands of the Government of India. But future events have placed beyond the shadow of a doubt the truth of the popular saying, 'Do not prophesy until you know.' The Indus Valley Railway in the half-year ending 30th June 1883 has "earned Rs. 4,94,223 in excess of the interest on the money expended on it as a *first-class line*." *Verbum Sap.*

Notes and Comments.

ROHILKHUND AND KUMAON RAILWAY.—The Directors of this line intimate that, subject to audit, the net earnings admit of the payment of a dividend for the half-year of £2-5 per cent., tax free, Indian and English.

AN ACKNOWLEDGEMENT.—We are in receipt of a Proof of Selection from the Records of the Government of India regarding the failure of the Kali Nadi Aqueduct—Lower Ganges Canal, and hope to notice it at an early date.

A COMING TEMPEST IN THE MADRAS HARBOUR.—It was resolved at the last meeting of the Madras Port Trust that the Engineer be informed that he is incurring responsibility by his non-compliance with the Board's instructions!

OFFICIAL INTELLIGENCE.—A telegram from the Chief Commissioner of Burma dated Rangoon the 1st instant reports that the last rails on the Upper Burma line were joined at noon on the 29th March; and that there is now a through line to Mandalay.

SUSPENSE.—The delay in filling the vacant Chief Engineerships in the Upper and Lower Provinces is, to say the least, suspicious. Let us, however, hope for the best—that the delay is due to a desire on the part of those at Simla to avoid—"jobbery."

TONNGHOO-MANDALAY, RAILWAY.—Colonel A. LeMessurier, R.E., of the Government Consulting Railway Engineers Department, will leave for Rangoon about the middle of this month to inspect and report on that portion of the Tounghoo-Mandalay extension that has been completed and ready for traffic.

ATTEMPTING TOO MUCH.—The Ceylon Spinning and Weaving Company is making great progress. The Memorandum and Articles of Association have been already published, and the Company will soon be floated. The promoters of a second Company intend to combine cotton-growing with the work of a cotton mill.

P. W. D. ADMINISTRATIVE CHANGES IN BURMA.—Colonel Cumming assumes charge of the Province as Chief Engineer on the departure of Major Gracey, who goes on furlough this month. There are to be four Superintendents of Works, with head-quarters at Rangoon, Thayetmyo, and the other at two stations in Upper Burma.

BETWA CANAL, N. W. P.—We have received a series of articles based on the Selection from the Records of the Government of India regarding this project. They are from an Irrigation Officer in the Upper Provinces, whose initials are familiar to our readers, and we hope to give them publicity when the pressure on our space diminishes.

CANAL VERSUS RAILWAY.—The project of an Indo-European canal by way of the Euphrates Valley and the Persian Gulf, will, it is claimed, realize two important results, namely, those of irrigation and navigation, and thus restore fertility to those vast wastes. Such a canal would shorten the present route of going and coming to Bombay some six days.

OFFICIAL INTELLIGENCE.—Information has reached the Government of India that Mr. Andrew Dalgleish, the well-known Central Asian trader, has been shot between Karakoram and Whabza Zilga on the way to Yarkand by a Kakar Pathan. The body is being brought to Leh for burial. No further particulars of this unfortunate occurrence have yet been received.

FAIR TRADE.—The restoration of the cotton duties seems now to have come within the range of possibilities. English politicians are becoming impressed with the fact that the abolition of the duties was a great injustice to India, and it would not be very difficult to reconcile the people at home to the abandonment of an advantage which was given to them unjustly.

MYSORE P. W. D.—We hear Mr. Inman is shortly to proceed on leave, and Mr. Govindacharlu to relieve him. But if Mr. McLaughlin—now on the Assam Behar line—who is to return shortly be retained in Bangalore, Mr. Govindacharlu will continue as Executive Engineer for the Channel Department. Mr. Inman will, it is rumoured, be posted to the charge of a new bridge division which will, it is said, be formed.

ANOTHER PAPER MILL.—We have always advocated the introduction of Paper-Mills in Southern India, and believe that our efforts in this direction have had something to do with that started in Travancore. We are glad to find the question of a Paper-Mill for Bangalore taken up locally, and have no doubt that a well managed mill will pay its way handsomely, particularly when started under the auspices of the Mysore State.

FORESTRY AT COOPER'S HILL.—In order to afford the forest students at Cooper's Hill College suitable instruction in organic chemistry, the Secretary of State for India has sanctioned the expenditure of £105, as the salary for a lecturer on the subject. This is chiefly due to the representations of Dr. Schlich, who was for some years head of the Forest Department of this country, and now holds an appointment at Cooper's Hill.

INDO-EUROPEAN TELEGRAPH.—The Directors of this concern after adding £10,000 to the reserve fund, have determined, subject to audit, to recommend the payment of a dividend for the six months ended 31st December 1887, of 17s. 6d. per share, making, with the interim dividend already paid, 6 per cent., for the year, and a bonus of 20s. per share, both free of income tax, making in all 10 per cent., for the year, carrying over £2,695.

BOMBAY ROADS.—We find that the cost of repairing the Municipal Roads in the City of Bombay during the year 1886-87, actually came up to Rs. 3,18,663. We should like to know the corresponding figures for Madras and Calcutta. The latter City however labors under the disadvantage of having no local metal, that used being either imported as ballast by the shipping, or brought from a distance of a couple hundred miles by rail.

THOUSAND-TON TRAINS ON THE E. I. R.—The economy involved in the working of these trains, is believed by some to be more speculative than real. The question

no doubt is one which requires thorough investigation and elucidation before arriving at any conclusion, but as we can scarce afford the time to undertake the task, we would invite free discussion on the *pros* and *cons* of the subject by those best qualified, so as to set at rest this, ever recurring, question.

A NEW DEPARTURE.—The appointment of Mr. R. G. Macdonald to officiate as Accountant General of the Public Works Department, until the return from furlough of Major A. C. Begbie is worthy of note, as it marks a new departure from the accepted order of things. The head of the Accounts branch of the P. W. Department has hitherto always been a Royal Engineer officer, and the post has been from its formation regarded as reserved for a military officer. A civilian has now for the first time obtained the prize.

THE BUCKINGHAM CANAL.—With the exception of the crossing of Manneru and Pennar rivers and the canal from 111th mile to the 119th mile (the portion north and south of the Pennar), the navigation of the canal is very fair, and by end of the year, when the diversions that are now approaching completion are all opened, there will be a great improvement, and with careful maintenance, there should be no difficulty with regard to the navigation. This is saying a great deal for a tidal canal along 262 miles of Coast.

SCIENTIFIC AND USEFUL.—A new discovery has been made in connection with the manufacture of indigo, which will prevent the serious waste of much valuable dye that occurs under the method of manufacture now practised in India. It is a very powerful antiseptic, prepared from coal tar, having the property of immediately checking fermentation. Minute quantities diluted with water and thrown into the vat when the point of maximum production of color has been reached, will secure a better outturn than is obtainable at present.

MINING IN CHINA.—An English Engineer named Church has been engaged by the Chinese Government to superintend the working of the gold mines of Pingtu, the copper mines of Ping-Chouan, and various other mines in Northern China. Machinery of the most recent type is being bought, and the mines are to be worked on the modern system.—The Tsung Li Yamen and Boards of Revenue have submitted a memorial to the throne urging that the development of the gold mines of Manchuria near the Russian frontier should be undertaken.

IRRIGATION IN THE DECCAN AND SIND—A COMPARISON.—We take the following from the Bombay and Sind Irrigation reports for the year 1886-87. The total capital expenditure on Irrigation Works in Bombay (Deccan) to date is £2,202,352 (at Rs. 10 the £). Revenue during the year—£,611, which, with the interest charges, gives a net loss of £23,809 on the year's operations. Sind with a total capital outlay of £1,132,842—about half that of Bombay—gave a net profit of £155,215 on the year, after deducting all charges including interest.

RAILWAY PROBLEMS.—Railway problems are always ticklish things and the inauguration of the bogee engines on the E. I. R. was at the time considered a departure which "bid fair" to surprise many, and carry in its train sweeping changes in the advantageous working of trains. But the experience of the past few years points with the finger of reproach to the contrary! These locomotives are far too heavy and cumbersome, and the cost of renewals great, not to speak of their oscillation which seriously affects the condition of the permanent way.

THE BOMBAY BOILER ACT.—We are induced to give the fees intended to be levied for the inspection of boilers in Western India for purposes of comparison with those imposed elsewhere :—

For the inspection of each boiler attached to a prime mover not exceeding 10 H. P. nominal ...				Rs. 15
Do. do. exceeding 10, but not exceeding 20 do. ...	20 do. ...	..	..	20
Do. do. 20, 30 do. ...	30 do. ...	..	..	25
Do. do. 30, 50 do. ...	50 do. ...	..	..	30
Do. do. 50, do. do. ...	do. do. ...	..	..	40

BOILER INSPECTION IN THE MOFUSSIL.—From the reports that we receive from time to time of the progress of work in this direction it appears that the extension of the Steam Boilers Act to the Burdwan District has not been a day too soon. If we are creditably informed, nearly 50 per cent of the boilers are in a state that may be described as *dangerous*. We should be glad to have thoroughly reliable information on the subject, but as this can only be obtained through the proper channels—the Government—we hope before long to have the Official Report to deal with.

GOLD IN CEYLON.—The re-discovery of the precious metal in the Southern Province of Ceylon continues to occupy a large share of public attention. The apathy of the Government in past decades is truly astonishing ; they have never even taken the trouble to get a competent geological authority from India, or elsewhere, to prospect the country. Mr. A. C. Dixon's meagre efforts being the only official interest taken in the subject. In our opinion it is not a question of whether there be gold or not, but whether it exists in paying quantities, and this we are disposed to doubt.

PORT ARTHUR.—The graving dock and basin are making rapid progress and are said to present an animated appearance, there being over 5,000 people at work. It seems that more than half of the work undertaken by the French Syndicate is finished, and as it is only twelve months since they started operations, it is likely that before the end of another year from now, if nothing unforeseen takes place, their part of the work will be finished. Instructions have been given to hasten the work, as it is inconvenient for the Northern fleet to go South or to Nagasaki for the purpose of docking.

THE BOMBAY P. W. D.—The last *Gazette* intimations show, that Mr. J. E. Whiting, M.A., INST. C.E., has been appointed as Chief-Engineer for Irrigation and Superintending Engineer, Central Division, with the title of Chief Engineer Central Division, *vice* Colonel C. A. Goodfellow, V.C., R.E., proceeding on furlough. Lieutenant-Colonel J. D. Cruickshank, R.E., acts as Superintending Engineer, Southern Division, *vice* Mr. Whiting, Mr. W. H. Le Quesne acts as Executive Engineer, Nira Canal. We may have occasion to comment again on the Bombay system of P. W. D. promotions and designations.

THE BENGAL COAL FIELD.—The trade in the *black diamond* just now, is not so brisk as it was some time ago—a circumstance due to the rapid falling off of the demand and comparatively large production. As a rule, stocks laid in in the dry weather, between April and July, are disposed of during the rains when most of the mines owned by native proprietors are flooded out. As compared with the rains, the out-put in the dry weather is larger, but the sales toward the closing of that season are restricted. Almost the whole of the up-country trade in this article is in the hands of the E. I. R., the Bengal, and the Raneeungee Coal Association.

FORMOSA PUBLIC WORKS.—The Chinese Government is about to undertake a series of public works for the purpose of opening up the island of Formosa. Among these are a line of fast steamers between Formosa and Tientsin—a new city, Tai-pei-fu, to be a fortified centre and the residence of the Governor of the island, a railway across the north of the island to Kelung, and a telegraphic cable uniting Tamsui, in Formosa, with Foochow on the mainland. A large American house has secured the order for the first two steamers. There is likely to be a great deal of competition among foreign houses to secure a part of the proposed works as soon as they hear of them.

CENTRAL ASIA.—According to the *Pioneer* the gauge of the Trans-Caspian proves to be the same as that of the great railway system in Russia itself, *viz.*, 5 feet—not a narrow gauge similar to that of the Rajputana Railway as we at first believed. By thus having one gauge of 5 feet throughout, from the Caspian to the heart of Central Asia, the military authorities can in case of emergency draw upon Russia for as much rolling stock as they may require, the shipments being easily made from the Volga. The long sidings constructed at the most important stations show that strategical requirements have been carefully kept in view—the mere commercial traffic would not necessitate such a provision for 20 years to come.

MADRAS CANALS.—There are 1182 miles of navigable canals in the Madras Presidency, *viz.*, the Godavari, 456 ; Kistna, 281 ; Kurnool 190 ; and Buckingham, 262. In 1886-87 there had been a falling off in the traffic on all the canals as compared with the previous year, although the receipts on the Buckingham canal were slightly larger. The working expenses of all the navigable canals is considerably in excess of the receipts. The Buckingham canal, which is purely a navigation canal, was worked at a net loss of Rs. 51,952 ; this result is, however, considerably better than that obtained in the previous, or from an average of the past, three years. The Kurnool canal continues to be extremely unpromising in its progress.

THAYETMYO REDOUBT.—A military prison is to be constructed at Thayetmyo. The new R. A. *pucca* barrack inside the Fort will be converted into a military prison. The estimate has been forwarded to the Government of India for sanction. Total cost is Rs. 49,808. The prison will have 64 cubicals for accommodating 64 prisoners. The end rooms of the barrack (Sergeants' Quarters) will be used for accommodating 4 European warders. The chief European warder will live in the wooden temporary barrack adjoining the R. A. prison barrack. Two sides of the prison barrack are closed from ingress and egress by the ramparts of the Fort, the other two sides of the barrack will have an enclosure wall, allowing sufficient space for exercising prisoners.

A VERY SHORT-SIGHTED AND EXTRAVAGANT POLICY.—The course what now appears to be pursued in Burma in constructing Railways is that instead of being prepared to start another line, or continue an extension as soon as the sanctioned work is complete, the construction staff are withdrawn from Burma, and as, a rule, fresh Engineers, strangers to the country, collected to start the next Railway, and much delay and expense incurred before they can settle down to work. It is beyond dispute that Railways in Burma would be more useful than roads in pacifying the country and developing its resources, while roads

are most expensive in that country, take years to complete, and yield no direct revenue. The Indian Government should take a lesson from Russia, and hurry forward Railways before roads in newly acquired territory.

PUBLIC WORKS IN GWALIOR.—Signs of progress are becoming abundant in Sindia's State. Several public works are now being carried out. A hospital is being built at a cost of 5½ lakhs, from designs prepared by Mr. Harris, the State Engineer. This will be an imposing structure. A college, which is to cost about 3½ lakhs of rupees, is also being built under the superintendence of Mr. Brandreth, son of the Principal of Roorkee College. A two-storeyed dāk bungalow is being erected. A native rest-house, to cost Rs. 30,000, is also in progress. But this does not exhaust the catalogue. A park to extend the whole length of the Fort is to be formed, and to be endowed with a lakh a year. All these works are being carried out by Mr. Harris the State Engineer, who is allowed Rs. 20,00,000 annually for the maintenance of the Public Works Department.

BANGALORE WATER-SUPPLY.—After much discussion, the Municipality were resolved that no other project for the water-supply of this station having been presented to the Board for consideration, as they were led to expect would have been done from what the President had stated at the Board's meeting of the 25th February last, and as General Fischer's scheme appears to have attracted the favourable attention of the Government of India, the Board resolved to submit, through the Resident, to the Government of India, for the professional opinion of the Departments under them, the notes and plans received from General Fischer for enlarging the Hebbal Reservoir and pumping the water to the highest point of this Station, with the shortest main and least lift, from the best available drainage area in its immediate vicinity; the whole work up to the distribution reservoir being estimated to cost three lakhs of rupees.

THE VICEREGAL PALACE, SIMLA.—Mr. Irwin promises to have the work ready by next September, but we understand that in all probability the palace will not be ready till some time next year. Elaborate tablets have been placed at the entrance stating that the palace was built during the Viceroyalty of Lord Dufferin and that Mr. Irwin was the architect, and Messrs St. Clair and Hebbert the Executive Engineers. The palace is well-built, but diversity of opinion exists on the beauty or usefulness of the stone lions and tigers that guard the porch with gilt flags in their paws. The building will cost over Rs. 8,50,000, the furniture is estimated to cost Rs. 2,00,000, and the outlay on lighting the palace by electricity will probably cost over a lakh and a half of rupees. The total estimated outlay is therefore Rs. 12,00,000. Probably, however, Rs. 13,00,000 will be the ultimate figure.

INDIAN RAILWAYS—AGAIN.—Mr. J. E. O'Connor, head of the statistical branch of the Department of Finance and Commerce, has recently issued a fresh volume of statistical tables for British India in the form of a blue book. From this we find that the total mileage of railways open at the close of last year, was 13,385½ and the total mileage under construction was 3,224½. The total expenses of the railways have absorbed 47·9 per cent. of their total earnings. The total number of passengers carried on the lines increased from 22,251,496 in 1873 to 84,489,521 in 1886, while the number of tons of goods and minerals conveyed rose from 4,084,748 in 1873 to

19,583,204 in 1886. The gross receipts per mile on the four chief Indian Railways during 1886 were Rs. 30,157 on the East Indian (State), Rs. 28,785 on the B. B. & C. I., Rs. 25,890 on the G. I. P. and Rs. 20,595 on the Eastern Bengal (State).

JUBBULPORE TRAMWAYS.—The promoters will commence the work of laying down this tramway within 12 months from the date of the authority (to do so) being vested in and communicated to them; and the tramway will be completed and opened for public traffic within a period of six months after the expiry of the aforementioned period of 12 months. A sum of Rs. 5,000 has been deposited by the promoters subject to the following conditions:—(a) That if the laying of the tramway is not commenced within the period of 12 months, the concession having lapsed, the deposit of Rs. 5,000 will be returned to the promoters. (b)—That if the laying of the tramway has been commenced within the aforementioned period of 12 months, the Rs. 5,000 will remain in deposit until the opening of the tramway or until the expiry of the further mentioned period of 6 months. (c).—That if the laying of the tramway has been commenced within the aforementioned period of 12 months and is not completed within the further mentioned period of 6 months, Rs. 2,500 of the deposit will be liable to forfeiture.

BOMBAY WATER-SUPPLY.—A local paper says:—We called attention last week to the portentous determination of the Government of India to refuse to allow the balance of the Tansa Loan to run for sixty years. The Supreme Government had laid down the rule that the Corporation must not borrow for a longer period than forty years. That there should be a general rule limiting the period over which Municipal loans should run may be conceded; but as we pointed out, the cost of water works, which are destined to supply not only the present and the next, but all future generations, with an abundance of pure water may fairly be charged to those who will enjoy it during the ensuing sixty years. If it be legitimate to make those who shall inhabit Bombay forty years hence contribute their quota to the cost of Tansa, where is the injustice or the impropriety of making the obligation extend over twenty years longer? It is a question of financial convenience and perhaps of financial necessity, whether the repayment of a loan raised for such a work be spread over twenty or forty or sixty years.

AGRICULTURAL IMPROVEMENT IN INDIA.—Principal Robertson of the Madras Agricultural College says that experimental farms, agricultural shows, and other familiar expedients were tried for a long time in Madras just as they have been tried in Northern India; but the progress made was slow, and it was gradually recognised that the desired reforms could only be effected through the agency of the natives themselves, and that this again could not be enlisted until a system of agricultural instruction was established. The result was the creation of the school at Saidapet, and Mr. Robertson's remarks on the effects produced by the training given there, are of the utmost interest and importance. "The college," he says, "has fully realised the expectations under which it was founded," and "is proving especially beneficial in bringing back to agriculture the more intelligent and enterprising natives, who under the influences of a purely literary education were gradually abandoning the pursuits of their forefathers for careers which, even to the successful, held out nothing better than a poor clerkship under Government."

Current News.

SIR EDWARD BUCK takes leave in October, not in August, as was at first stated.

MR. MILLER, Managing Director, Bengal-Nagpur Railway, left India by the last mail.

It is said that the meteorological conditions at present do not give promise of an early Monsoon.

THE Government of India is taking no official part in the Brussels International Exhibition.

CAPTAIN A. HILDEBRAND, R.E., is transferred from the Mirat to the Chakrata Division, Military Works.

THE construction of the Miraj-Kolhapur Railway line was commenced last week, H. H. the Maharaja of Kolhapur cut the first sod.

WE learn that the traffic office of the Tirhoot State Railway, which is at present located at Somastipore, will be transferred to Mozufferpore.

ON Sunday evening last a serious fire broke out at the Cawnpore Jute Mills. The loss, which is covered by insurance, is estimated at Rs. 75,000.

THE Hyderabad Mining scandal continues to cause great stir at the India Office. *Truth* in its last issue reveals many details regarding the negotiations.

It is calculated that in four months there will be through railway communication on the broad gauge between Sibi and Quetta by way of the Bolan Pass.

THE Telegraph Department reports that telegraphic communication between the Rangoon lines has been restored, as well as that on the Moultmein route to Siam.

THE Government of India have decided that a military officer in receipt of a consolidated salary, cannot claim exemption from income-tax on any portion of the salary.

THE value of India as a market for Baku petroleum is coming to be recognized in Russia. Last year the exports from Batoum to this country amounted to seven million gallons.

THE broad-gauge bridge over the Peela Nuddee, on the Bengal-Nagpur Railway, between Nagpur and Kamptee, has been opened without formality for the passage of trains.

ACCORDING to a correspondent of the *Pioneer*, Mr. Watson has stated that Abdul Haq got one quarter of the mining concession, and sold his own shares to the Nizam's Government.

THE official report on the now historical disaster at No. 11, Kyd Street attributes the collapse of the building chiefly to the rottenness and originally faulty construction of the walls.

MR. TOUSSAINT of the Geological Survey is said to have reported very favorably indeed on the Kashmir Maharajah's sapphirine mines in Zanskar, the stones being very fine indeed.

MR. HARRINGTON BROWNE, the expert who came out to report on the Burma Ruby Mines, has left Simla for England, having first given the Government of India the results of his survey.

THE Bolan Railway was closed for traffic from the 6th instant, owing to the works in progress on the high level line. An accelerated train-service will be provided on the Hurnai route.

A FIRE occurred in the Calcutta Hydraulic Jute Press the other day, and caused damage to the extent of Rs. 20,000. A block of godowns, stored with bales of cotton, was completely gutted.

SURGEON F. C. REEVES having been appointed to officiate as Deputy Assay Master, Calcutta Mint, *vice* Surgeon-Major H. P. Yell, received charge of his office on the forenoon of the 24th April, last.

HER Majesty's Secretary of State for India has accorded sanction to the Revised Estimate, amounting to Rs. 2,04,44,339, of cost of constructing the Tounghoo-Mandalay Extension of the Burma State Railway.

THE Governor-General in Council has received with satisfaction the information that His Highness the Nawab of Cambay has abolished imposts upon trade, and all special taxes on trade and industries in his State.

A SCHOOL of Art is to be opened in Hanamkonda, in the Nizam's Dominions, to teach weaving cotton and silk goods, carpet making; for all of which Hanamkonda offers the cheapest materials, and best facilities.

A COMET is said to be visible now at about three in the morning due east, and can be seen between four and five. It is very faint, and occupies about two-and-a-half degrees in length. The comet is directed slightly towards the south.

OWING to some difference with the Harbour Trust Board, it seems certain that the Superintending Engineer, Mr. F. N. Thorogood, is to relinquish charge of the works in three or four months—or as soon as his successor is found.

MR. N. G. MUKERJI, the Cirencester graduate, has for some time past been engaged on an enquiry into silk-worm rearing in Bengal. He has now been deputed to Europe to learn the system at one of the Continental rearing farms.

THE P. W. D. at Mandalay are busy collecting the materials for the Courts. These will be very fine buildings, in the European quarter, not far from the Railway. They will supply a great want, as the present accommodation is very inconvenient.

COMPLAINTS are rife that punctuality in the arrival and departure of passenger trains in the Southern Section of the Eastern Bengal State Railway is very seldom observed. We would invite the attention of the Manager of this line to remedy the evil.

A TERRIFIC storm visited Moradabad on the 30th ultimo, uprooting nearly all the trees, unroofing almost every bungalow, and killing 150 Natives. The hail-stones were of unusual size. A similar storm, though less violent, visited Delhi on the following afternoon.

COLONEL TRAILL, R.E., Examiner of Public Works Accounts, Bengal, left Calcutta for Bombay on Tuesday *en route* for England on furlough. The next mail will take several distinguished R.E.s home, Colonels Filgate and Firebrace being amongst the number.

THE conversion of the Nagpore-Chatisgarh State Railway from metre gauge to broad is being rapidly carried out, and the rails on the standard gauge have now been laid five miles beyond Raipur, thus enabling heavy material trains to work along nearly 200 miles of the line.

AT the close of the year under review, there were in all 952 boilers on the register, in the town and suburbs of Calcutta, including Howrah. Of these 53 were new boilers. Out of the above, 804 boilers have been examined by the Engineer-Inspector and his assistant, against 751 in 1886, 752 in 1885, and 707 in 1884.

THE charges incurred on account of the Dowlaishweram Workshops, Godavery, Madras, during 1886-87 amounted to Rs. 13,710, or Rs. 23,172 including depreciation of buildings and machinery, leave and pension allowances, and interest on capital, while the profits were Rs. 7,548, the result being a net loss of Rs. 15,624.

THE Calcutta Workshop Division at Seebpore, which has hitherto been a separate executive division, has been abolished, and the works comprised in it, together with the buildings, &c., of the Government Royal Botanical Gardens, have been amalgamated with the Second Calcutta Division, with Mr. Toogood as Executive Engineer.

ON the new road from Murree to Kohala, which has been opened for traffic, there will soon be, it is hoped, a regular tonga service. There is already from Kohala about 40 miles of tonga, service; but beyond that the road is not finished, although it is being pushed on. General de Bourbel is in charge of the whole road in the Kashmir State.

THE Indian Tramways Construction Company Limited, has been registered with a capital of £80,000 divided into 16,000 shares of £5 each, with power to increase or reduce the capital. The stated object is to acquire, by purchase or otherwise, concessions relating to, or in connection with tramways, light railways, or other public works in India or elsewhere.

THE broad gauge line between Hirokh and the Kotai in the Bolan, is making great progress. It will be necessary shortly to close the loop line up the Bolan as the work of construction will probably prevent traffic on the metre-gauge section. If all goes well, it will be possible before another four months to run through trains from Quetta to Sibi *via* the Bolan.

FROM the Annual Report of the Karachi Chamber of Commerce we find that there was a remarkable falling off in the wheat trade at that port, which is ascribed partly to the failure of the wheat and grain crop in the Panjab owing to an abnormally scanty rain fall, and as the land of the five rivers is its main source of supply, the result was unavoidable.

WITH reference to the proposed afforestation of the Ynrafzai subdivision of the Peshawar district, the Superintending Engineer of the Bari Domb Circle has reported that all plantation operations on the Swat River Canal have hitherto been entire failures, and that he is under the circumstances unwilling to undertake any extended operations on the Canal account.

COLONEL CONWAY-GORDON has returned to Simla. Notwithstanding the abolition of his office, he continues to bear the designation of Director-General of Railways, in addition to being an *ex-officio* Deputy Secretary to the Government of India in the Public Works Department, though it is probable, we hear, that the former office may, before long, be changed into that of Inspector of Railways.

THE net value of gold imported to this country from the beginning of the official year to the end of March, was Rs. 2,98,91,710, and that of silver imported was, Rs. 9,21,87,504, making the total net imports of the precious metals Rs. 12,20,79,214. The assay value of coins and bullion received in the Indian Mints during the same period was, Rs. 10,89,85,391, and of the same coined and examined Rs. 10,84,13,665.

ON the 3rd instant a rather serious accident occurred on the Rajputana-Malwa Railway, between Pansar and Kuld stations, to a goods train. Seventeen wagons were totally wrecked, and the contents strewn all over the place. The line was torn up about 250 yards, and the Engineering Department is busily engaged in repairing it. The accident was caused by the breakage of an axle in one of the wagons centrally situated, and this is the fourth or fifth accident of the kind.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

P. W. D. SUBORDINATES.

SIR,—There have been comments in your Journal from time to time regarding the non-gazetting of P. W. D. subordinates. Now, I have an idea that if the promotions, &c., of the abovementioned class were issued on flimsies with the Nos. of *I. E.*, it would be appreciated by many of the subscribers, and the paper would benefit both pecuniarily and in popularity. "The happiness of the greatest number" will be secured if you can think as

April 18, 1888.

CON CREGAN.

[How is the above required information to be obtained? As far as we are aware the *Madras Gazette* alone affords the desideratum.—ED., *I. E.*]

P. W. D. GRIEVANCES.

SIR,—I was no less surprised than pained to see in your last issue that the "meritorious officer" Rai Prosanna Coommar Banerjee, Bahadoor, has been granted a further extension of service till August 1889. Now, to say the least, it is too bad of Government to grant such repeated indulgences to old and withered officers who have served out their time, and I believe also made their competence, if not their "pile", to retire on without missing any comforts. The promotion in the subordinate grade is slow enough, as it is to make a saint disgusted with the service, and if the 55 years rule is not rigidly enforced, the younger meritorious officers will have no chance whatever of getting on in this world. God knows, there is discontent enough already in the subordinate grades on the score of slowness of promotion, and it seriously detracts from the efficiency of officers to have to work on under a depressing sense of injustice and wrong, especially men who feel that they deserve to be better treated than they are.

April 29, 1888.

A SUB.

A REASONABLE DEMAND.

SIR,—In your issue of 28th April I notice a letter headed "A Cry for Justice," which I hope will find an echo from the native members of the profession.

But I for one would take a different view altogether, and instead of *begging* for promotion to higher ranks, a thing perhaps to some extent denied us by the fact of our being a weak minority as Mr. R. N. B. puts it, I would merely ask for extension of furlough and pension rules to native Engineers in equality with the European members. To the former I would add a proviso that the period is spent out of India, and by the latter, I mean the privilege of retirement after 20 years' service on Rs. 4,000 a year without medical certificate. If the last was granted, a native Engineer, who considered himself unduly passed over, and at the same time had the self-confidence of possessing the talent required for higher appointments, could certainly deserve getting a chance of shewing his worth by starting private practice, for which I believe there is ample field in India. It must be highly distasteful to any man, and especially to a professional man of any worth, to ask favors for the reward of his merits. A good article must demand the deserved recognition, provided the possessor has a chance of exhibiting it to the public. I believe it would also be in the interests of Government as well of the profession to create a healthy field of private practice, thereby aiding the development of the resources of the country, and at the same time removing from the ranks a discontented lot.

In conclusion, I must point out the absurdity of your deducing any reliable inferences from the evidence of the members

of the superior grades, by drawing your attention to the following facts:—

(I.) That no native Engineer has been given a trial in the higher posts.

(II.) That their total number at the best of times is no more than 6 per cent.

(III.) That most of them receive little, if any, of fair treatment, much less encouragement, at the hands of their superiors.

A NATIVE ENGINEER.

P. W. D. UPPER SUBORDINATES IN BURMA.

SIR,—I am extremely glad to see that you have time and space to speak up for that hard-working body of men classified under the head of Upper Subordinates of the P. W. D., more especially for the men serving in Burma. Your issue of the 7th instant warmly advocates in one of its paragraphs the retention of the temporary hands taken on at the commencement and during the Upper Burma campaign. With all due deference to our *compères* of Bengal, I am of opinion that you are quite correct in the main that old hands, or rather men of mature age, if appointed to Burma from Bengal, the interests of the Department would suffer, as it is hardly to be expected that these men will be able to prosecute their work with that zeal and vigor which young men, who have already had experience in Burma and can speak the language of the country, are able to do. Among the dozen of temporary Upper Subordinates (which I believe is about correct) there are some who have had experience in works. It will be a regrettable incident if the services of the most hard-working men are overlooked. These temporary Subordinates have been exposed to fire and have also been under fire from dacoits. At a time when men were to be had with difficulty and were urgently required, these gentlemen offered their services, and served the Government in a devoted manner, risking their person and life in order to perform the work required of them—at a most critical period during the Upper Burma campaign; and are the services of such men to be ignored, Mr. Editor? I have been an eye-witness and know how some of these men have acquitted themselves. It will be very unjustifiable for financial reasons to dismiss them and get others in their place. If Government cannot appoint all, a selection might be made and some taken. It is hoped Colonel Cumming, the Chief Engineer, will succeed in urging on the Government of India, through the Chief Commissioner, the necessity of making some permanent appointments. The Police have fared far better than the P. W. D. I have several friends in that non-enviable Department, who started as 3rd grade Inspectors without any previous experience and who are now A. Ss. and D. Ss. I wish them all good fortune, but why did not Government indent on Bengal. A few men were sent, but the majority were appointed locally, the main reason being, young and active men were wanted and were thus appointed. Not much experience was wanted of them, they were to gain it here, and if then found unfit, were either to be dismissed or kept down. Among the temporary men of the Upper Subordinates experience and youth are both to be found.

TEDDY.

REORGANIZATION OF THE D. P. W., MADRAS.

SIR,—This once famous Department has been so often reduced and reorganized till it is now almost a useless department, and might well be called the Public Waste Department.

Prior to 1881, the Department consisted of District Engineer with rank of an Executive Engineer, and four or five Range Officers for each District, and a Taluq Overseer for each Taluq. The duties of a Taluq Overseer were to prepare estimates for roads, buildings and all irrigation works within his Taluq, so that it was next to impossible to neglect any irrigation work, road or building long.

After the above year the Department was reduced, or I should say supposed to be reduced.

The roads were handed over to the Collector as well all irrigation works, which irrigated less than 200 acres, and the repair of all civil buildings costing less than Rs. 1,000, leaving the Public Works Department to look after military buildings and irrigation works which irrigated over 200 acres. If the Kistna and Godavery works were omitted, the works irrigating over 200 acres could be counted on one's fingers, and to superintend the small number of works we have 6 Superintending Engineers, 41 Executive Engineers, 41 Assistant Engineers, 185 Subordinates, besides 2 Chief Engineers, and 2 Deputy Chief &c., and a large staff of Examiners, Deputy Examiners, Accountants and Clerks.

In addition to this large staff we have the Local Fund Engineering establishment. The Collectors finding that they could not attend to the irrigation works, and the revenue from this source falling every year, represented the matter when Government formed another Department called the Tank Restoration Department; the duty of this Department was to frame estimates for irrigation works only; which, when sanctioned, are handed over to the Public Works Department for execution. Considering the present financial state of the public purse, the number of estimates prepared by this Department are not likely to be sanctioned for years, and when sanctioned, will all need revision. In the meantime irrigation works are getting from bad to worse, the result being a falling off in revenue and misery to the poor ryots.

If the cost for supervision of works carried out by the D. P. W. proper is taken into consideration, I am sure it would be found to be more than 250 per cent, and to this if the cost of preparing estimates be added, it might be safely put down at 350 per cent. If this system of wasting public money continues much longer, taxes will have to be increased, and poor ryots ruined for life. With an extra assistant to each Local Fund Engineer, the Collectors could look after all the works in their respective districts; they did it before and did it well with not half the present Engineering staff, and could do it again. Leaving the Godavary and Kistna Districts to the D. P. W. and the Military Works under military officers placed directly under the Inspector General Military Works, the rest of the officers and subordinates, Examiners and Deputy Examiners might with advantage be dispensed with; of course they all could not be sent adrift, but might be absorbed in Bombay, Bengal and Burma, thereby lessening the taxes on the poor inhabitants of the BENIGHTED PRESIDENCY.

NATIVE ENGINEERS.

SIR,—I am not surprised that you cannot comprehend the disabilities which handicap Native Engineers in the D. P. W., nor enter into their grievances and sympathize with their pitiable position. The reason is two-fold. In the first place you in common with most men of your race have naturally too high a notion of Europeans in general and their abilities; and in the second place your pride of race, and innate consciousness of your superiority in all respects, prevent you from mixing with educated Natives on a footing of equality, and thereby knowing them sufficiently to be able to judge of them correctly. Amongst Europeans in general, it is taken as an axiom that all Europeans are good for everything, and all Natives are good for nothing. These are the thoughts with which I rose from the perusal of R. N. B's "cry for justice" in your last issue and your stereotyped footnote thereto. I have no doubt that what you say are your own honest convictions, and I would have spared you the trouble of these observations and honest convictions of mine, if I could for an instant believe it possible for you to place yourself in the position of a Native Engineer, and look at his grievances from his stand point. As it is next to impossible for you to do so, so it is equally impossible for you to hold the balance evenly between Natives and yourselves. I do not blame you in the least. Indeed I should have been surprised if you held other opinions than you do. Your very nature, habit, mode of thought and training, in fact, your everything from your very childhood tends to impress on you your superiority to everything un-English. It is therefore hopeless to expect an impartial consideration of Native grievances from Europeans when European interests are mixed up therewith. I therefore do not in the least wonder that having nothing definite to say against the Native Engineers as a body from your want of knowledge of them, you are constantly reiterating the superiority of Cooper's Hill to Indian Colleges. In my humble opinion you are very much mistaken in your line of argument. The question is not at all whether the Cooper's Hill men are superior to Indian graduates. No one has been foolish enough to deny the superior advantages of an English training to that now obtainable in India. The question is this. Have the Government found the suitably trained men of our Indian Colleges unequal to the duties of Assistant and Executive Engineer in the P. W. D? Are the few Native Engineers now in the Department failures? If so, shut them out by all means, and get suitable men from elsewhere. Can you refer me to any record wherein the Government has declared it as its opinion that the Natives of the country are unfit for the grade of Engineers in the P. W. D? If you cannot, then why exclude the Natives from the Engineer grades? Why did you for twelve long years hermetically close the door of the P. W. D. against the passed graduates of the Calcutta College, and blast the prospects in life and peace of mind of about 66 young men for ever?

No, Sir, the whole truth of the matter is this. You are too selfish to let any but men of your race fill the better paid appointments in the P. W. D. Excuse my saying so, but the conclusion is most irresistible from what I have myself seen and suffered. You do not care about the Overseerships and Sub-overseerships, and you make a virtue of necessity by giving them to the Natives. I can understand your doing so. It is human nature to see one's kith and kin doing well before any one else. You have all the power in your hands, and it is but natural you should use it just as you like, and for your own benefit. I dare say if the Natives had the power in their hands, they would have done just the same. But when you talk of justice, it is a different thing altogether. I can understand your justice amongst yourselves. But between a Native and a European when it suits your interest to be unjust in nine cases out of ten you are so, say what you will to the contrary. No, you can not feel for the Natives in the public service. You can not even imagine how very humiliating and pitiable is their position, especially those that can think and feel. I am sure you would not like to be in their shoes for an instant. They would have been by far happier if you had not given them education, and raised in their minds, hopes and aspirations which you render practically unattainable for them in life. Excuse the length of this letter, Sir, and excuse also my

giving expression to my honest thoughts and convictions. I do not blame any one but our own fate.

A NATIVE ENGINEER NIPPED IN THE BUD.

3rd May 1888.

[This is a strong indictment against ourselves and against a good many others. It is a veritable impeachment, which calls for no rejoinder. Nevertheless, there is a ring of sincerity about the letter, and we believe it to be the outcome of "honest conviction"—such as it is.—ED., I.E.]

MR. DUBERN'S "ILLUMINATOR."

SIR,—The lengthy articles with which Mr. George Dubern has favored your readers call for some notice. It would seem from his first paper, that his speculations led him to believe that what he considers the "germs of life" were readily detectable if only his "conditions" were fulfilled; and arguing from his *a priori* basis he was led to construct his illuminator, and with its valuable aid to find what he was looking for, the germs of life, in that most unpromising of all media—strong nitric acid. Such a discovery, if it be substantiated, must revolutionize all biological science. The chemical structure of what has heretofore been regarded as the "physical basis of life" is extremely complex. The four principal elements which enter into it are carbon, nitrogen, hydrogen and oxygen, with traces of phosphorus, sulphur, &c. It has never heretofore been found except under conditions which enabled investigators to trace the sources from which these elements were derived. In the case, *e.g.*, of the yeast plant, the life-elements (C. N. H. O.) are all derived from a saccharine solution known to contain them; in the case of bacilli they similarly are derived from the organic fluids in which they are propagated; plants of larger growth derive them from earth, water and air; while the animal world derives them either from plants or animals. Mr. Dubern's "life-germs" are, however, sustainable, if his views be correct, by the only two elements which are available for nutrient purposes in nitric acid, oxygen and nitrogen. His "life-germs," therefore, differ so materially from all living substances heretofore investigated, that most trained biologists would probably say Mr. Dubern's moving particles cannot be living matter at all, and that to assert they are is to misconceive the nature of living matter.

Without, however, going the length of joining trained biologists in their views, it is sufficient to affirm that Mr. Dubern's "discovery," if it be substantiated, must of necessity revolutionize the whole science of biology. To do this in the off-hand fashion indicated in Mr. Dubern's articles, would certainly be the most remarkable walk-over a well trodden field of science, full of competent and trained competitors, which has ever been accomplished. Any one who has endeavoured to work systematically on any one object with the microscope, be that object an infusorian, or a rotifer, or a bacillus, or a bacterium, or any other minute organism, will know that the difficulties presented are not to be got over merely by improvements in methods of illumination, even assuming them to be improvements. Mr. Dubern would realize this if he carefully studied the record of the labors of Dallinger and Drysdale, still more so if he tried to follow them in actual research. It is work which is not to be accomplished in quite a *veni, vidi, vici* fashion; and implies a great deal more than illumination. Of course improved illumination is a help, and so are high powers; but whether the objects seen be real or imaginary, it is the mind behind the instrument which does the real work; and as might be expected, the trained mind does better work than the untrained, just in the same way that the trained Engineer is, in his own domain, a better workman, and a better teacher and guide to work than the untrained Engineer, or the mere tyro. To cross swords with biologists in their own fields of research is, therefore, a courageous feat on Mr. Dubern's part. If they were to say, on reading Mr. Dubern's own way of stating his case, that he approached his problems with a decided bias, and without due regard to previous research, it could scarcely be said that they exceeded their legitimate rights. And yet it does seem that, however perfect we may assume his method of illumination to be, Mr. Dubern advances further on his own way than is yet warrantable. The public know when he claims to have made his discoveries, because, in his own interests, he was careful so to fix dates as to prevent any one coming forward with a previous discovery. Your contemporary, the *Indian Daily News*, furnishes some landmarks in the history of Mr. Dubern's views. In the very short time, which elapsed between the invention, or discovery, of his "illuminator," and the announcement of his claims, no cautious observer with any training in biological research would have given his conclusions to the world in the definite terms in which Mr. Dubern published them. Moreover, he speaks, and always has spoken, very positively as to the animal nature of his "germs." He takes the breath out of less learned people by calling them *protozoa*, regardless of the way in which numerous objects, and notably a much larger and better studied organism, the *volvox*, have been bandied about between the animal and vegetable kingdoms. He always expected to find his *protozoa* less than the one hundred thousandth of an inch in size. No subsequent independent explanation of the phenomena he claims to have observed, which may be offered from a chemical or physical point of view, should therefore enure to his credit. His "discovery" stands or falls with the animal

nature, I might go further and say with the organic nature of the "germs" he speaks of having found: that nature constitutes his claim.

A word now with regard to this new illuminator. Mr. Dubern seems to assume that there is some special charm in polarized light for microscopical work; on his own showing he started with the *a priori* assumption that one of the necessary conditions for his work must be polarized light. *Why so?* Polarized light is applied in microscopical researches where crystals, fibres, and minerals are concerned, and in the hands of experienced microscopists it has done good work. But the biologist, the histologist, the pathologist, and a host of other special microscopical investigators never need polarized light and never use it for their work. While the bacteriologist considers a good substage condenser a *sine qua non*, he does not so regard a polariscope. Then again, in determining whether light is polarized or not, it is usually deemed necessary to employ what is known as an *analyser* of some kind or sort. I know of no other way in which the polarized nature of light can be tested and ascertained. No analysing prism, or other contrivance forms any part of Mr. Dubern's new "illuminator." He rests his claims in this particular on no such test. So far as his papers under notice carry the matter, he is satisfied that because his figure and lines, by a simple mathematical demonstration give a polarising angle, therefore his new illuminator must do the same. But in the case of a delicate scientific instrument is this kind of reasoning altogether safe? Unless I am mistaken, Mr. Dubern even in his figures has left out one little element of some importance in his calculation: *refraction*. As soon as his ray of light enters and emerges from his glass plate it is refracted; and it no longer proceeds, as his line on paper does, on a straight course. As I understand his figure and his argument, he makes no provision whatever for the necessary angle of refraction; and yet if I understand any thing of optics, that angle must be provided for; and if it is not, then his figure does not represent what takes place in fact, and his angles are all disturbed by these considerations, and the probability is that his light is not constantly polarized light.

Of course oblique illumination, or black ground illumination, is no new thing in microscopical optics; it can be secured in a variety of ways. Mr. Dubern may have discovered a fresh way of securing it; and if so, it may be that he has conferred a boon on microscopists. But before asserting all he does about his living germs, and starting a new theory of blood corpuscles (the "third blood corpuscle theory" has been exploded by further research), it might be well for him to submit the "illuminator" if he has not already done so, to Abbé, and to one or two other practical opticians, and to see also if the leading biologists are at one with him in his views as to life existing in the non-nutrient pabulum, nitric acid. He may be a great discoverer, the first to strike out an entirely new line of research which cannot but result in radical reforms all round; but he also may not be so.

If I am correctly informed Mr. Dubern's first actual discovery of his "life-germs" was made with a small non-achromatic instrument, giving a magnifying power with which no trained biologist would ever venture to look for germs. His claim at that time most emphatically was that his "illuminator" enabled one to observe "germs" with a much lower power, and a less carefully corrected set of lenses than is usually considered absolutely necessary. He still considers a quarter inch objective amply sufficient for work, for which a $\frac{1}{4}$ th, and more usually a $\frac{1}{8}$ th inch objective is employed.

He regards a binocular microscope as an advantage in examining the new "life-germs." Are the high-power objectives he says he used specially constructed for the binocular microscope? If not, how did he manage to use them? Then, again, in what way has he checked the binocular exaggerations of form? It was necessary for him to do so before announcing his preference for binocular vision. In a standard work on the subject we find it said "In the examination of new structures, no reliance should be placed upon the appearances presented by objects under binocular vision, unless controlled by the means pointed out" in the work from which I cite. Which of those means has Mr. Dubern employed? Long experience in actual work with the microscope on such objects as diatoms would help to convince him that there are illusory appearances, phantom lines and the like,—often due to illumination!—which have to be guarded against; and with which only long experience can familiarize an observer. Mr. Dubern apparently places no high value on the staining processes now in vogue; microscopists all the world over regard the art of staining as one of the latest and best developments of microscopical technique. Let Mr. Dubern for ever silence all possible objection to his "life-germ" theory by staining and mounting a few of his "germs." I urge this on his attention because every microscopist knows that mere motion in extremely minute particles is no proof of life, and workers are specially cautioned against accepting mere motion as such proof. If he claims to have watched his atomies reproduce themselves, then his researches should have already rivalled those which have made Dallinger and Drysdale famous all the world over amongst microscopists. Their labors had to be shared, and they relieved each other in their anxious watches; because they had to keep an organism in constant view, not for a few minutes or hours, but for very many weeks. Staining is a simpler process, and I therefore commend it to Mr. Dubern, because if there is as much in his discovery as he claims for it, he should be

able to stain his germs. If he wants them to be recognized as such, he must be prepared to submit them to the tests and cross-tests usually adopted in like cases amongst specialists; and he must not reckon his triumph secure if all he can show are bright sparks flashing across the darkened field of a microscope. As to his *dead germs*, it still has to be proved that they were ever alive! It may be doubted if biologists would accept Mr. Dubern's own positive assurances on this difficult subject as being equivalent to proof. He will understand I do not seek to throw cold water on his manifest enthusiasm. He must remember his speculations—I cannot at the present stage of the investigations regard them as any thing higher than mere speculations—have reference to a field which has been, and is being most thoroughly searched over. It is a field in which there still is the amplest possible room for discovery; but where so many biologists who have given as many years to the subject as Mr. Dubern has given months, are at work with appliances of the capabilities of which he can scarcely form a conception, and where so many have come to grief because they have hastily published ill-considered and untested conclusions, it might be well for Mr. George Dubern to have a care.

You must pardon this lengthy epistle. It is more suitable for a Microscopical than for an Engineering Journal; but as Mr. Dubern has had recourse to your columns, it is perhaps fitting that your readers should have something on the same subject from not quite the same point of view as that taken by Mr. Dubern.

MICROSCOPIST.

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QUARTERS FOR THE SUPERINTENDENT OF WHARVES, RANGOON.

THE quarters built in Rangoon for the Superintendent of Wharves, Soolay Pagoda Road, designed by Mr. H. M. Mathews, M.I.C.E., is one of the prettiest structures in the town.

The basement floor containing a dining-room and office is entirely of brickwork, and the upper floor, containing two bed-rooms, of teak timber. The cost was Rs. 8,000.

The construction of this house was carried out in 1877.

DRAINAGE OF TOWNS BY OPEN DRAINS.

By H. W. HUGHES, C.E.

THE necessity of good drainage in Indian towns has always been recognized by the sanitary officers of Government and it is almost impossible to over-estimate the value of the work that has already been done in the matter of town drainage by district officers, in most cases without professional assistance. The defects that might be expected are however generally to be found in such work and the outfalls are frequently defective and the sections of drains are often unsuited to the object they should fulfil. In the present day under the new system of local self-government such works will have to be initiated and carried out under Municipal Committees, and as so many schemes for water-works and other Sanitary improvements are proposed or likely to be proposed in nearly every town in the country the subject of town drainage is one that must be taken up by Municipal boards as one of the first, if not *the* first, to claim their attention.

It is readily admitted that good water and a plentiful supply of it is one of the first necessities of healthy life in India, but it is not so generally recognized that before introducing such a supply an efficient system of drainage must exist, or else an additional quantity of water being brought into a town is a positive danger to the inhabitants, for if the water is not properly carried away as fast as used it soaks into the ground and eventually every well in the place gets contaminated from infiltration of impure water and the air and soil of the locality tainted with the germs of disease. It therefore becomes a very responsible duty with persons in charge of the sanitation of a town to see that this important matter is not overlooked and that a *complete* and efficient system of drainage precedes an increased supply of water.

It is hardly necessary to say that the urgency of proper drainage is as great in towns where there is no regular "water-supply" provided, for although the quantity to be carried off is generally less, the injury to the population in event of polluted water getting into the wells would be greater as in this case people depend wholly on them for their supplies and the subject is one of equal importance to *every* Municipality, large or small, whether an increased supply of water is contemplated or not.

Many corporations are too poor to attempt to carry out a comprehensive scheme of town drainage at once, but this should not deter them from working up a *complete* project, so that whatever sums can be afforded from time to time for drainage works may be always spent on well considered works; for instance, if a house owner applies for leave to connect his house drain with the main drain there would be no difficulty *at the time* in insisting on his doing so in a proper manner, or if a short length of drain had to be made or relaid the portion so executed might be made of the section and on the level provided in the sanctioned scheme, and it would be found that very considerable progress could thus be made by keeping steadily to one plan from the first.

General objects of drainage.—In all towns of Upper India large enough to have a Municipal committee a

system of conservancy exists more or less efficient. Generally the solid portion of the excreta from houses and latrines is carried away by carts and disposed of by trenching or otherwise and under no circumstances enters the drains.

What drains carry.—Drains therefore have to carry—
1. The rainfall of the locality. 2. Sullage water from houses, &c.

Amount of Rainfall influences the size of drains.—The quantity of rain to be carried away has a very important influence on the size of the drains, and the peculiar circumstances of each locality should be well considered, and the best available register of rainfall for the locality carefully studied.

The following tables give the average monthly fall during the wet season in different towns in India.

Average monthly rainfall in some towns in the North-Western Provinces of India:—

	June	July	Aug.	Sept.	Oct.
Agra	2.75	10.09	7.15	6.36	0.43
Lucknow... ..	4.66	14.10	10.93	9.90	1.27
Benares	4.83	12.75	9.21	7.86	1.63
Barielly	5.57	15.57	8.19	8.14	0.75
Patna	7.06	10.44	8.05	7.42	2.57

Average monthly rainfall in some towns in the Punjab:—

	June	July	Aug.	Sept.	Oct.
Lahore	1.24	6.51	3.91	2.48	0.63
Delhi	2.18	7.54	5.57	6.13	0.57
Dehra Ismael Khan	0.91	1.68	1.42	0.82	0.13
Multan	0.22	2.31	1.15	0.37	<i>Nil</i>

Average monthly rainfall in some towns in Bengal:—

	May	June	July	Aug.	Sept.	Oct.	Nov.
Burdwan	3.98	10.56	12.12	11.60	8.65	5.33	0.38
Calcutta	5.40	12.08	12.78	13.94	10.18	5.61	0.55
Dacca	9.44	13.20	12.91	12.00	8.99	4.89	0.84
Ohit tagong	9.18	22.46	22.27	21.43	12.93	6.32	1.81

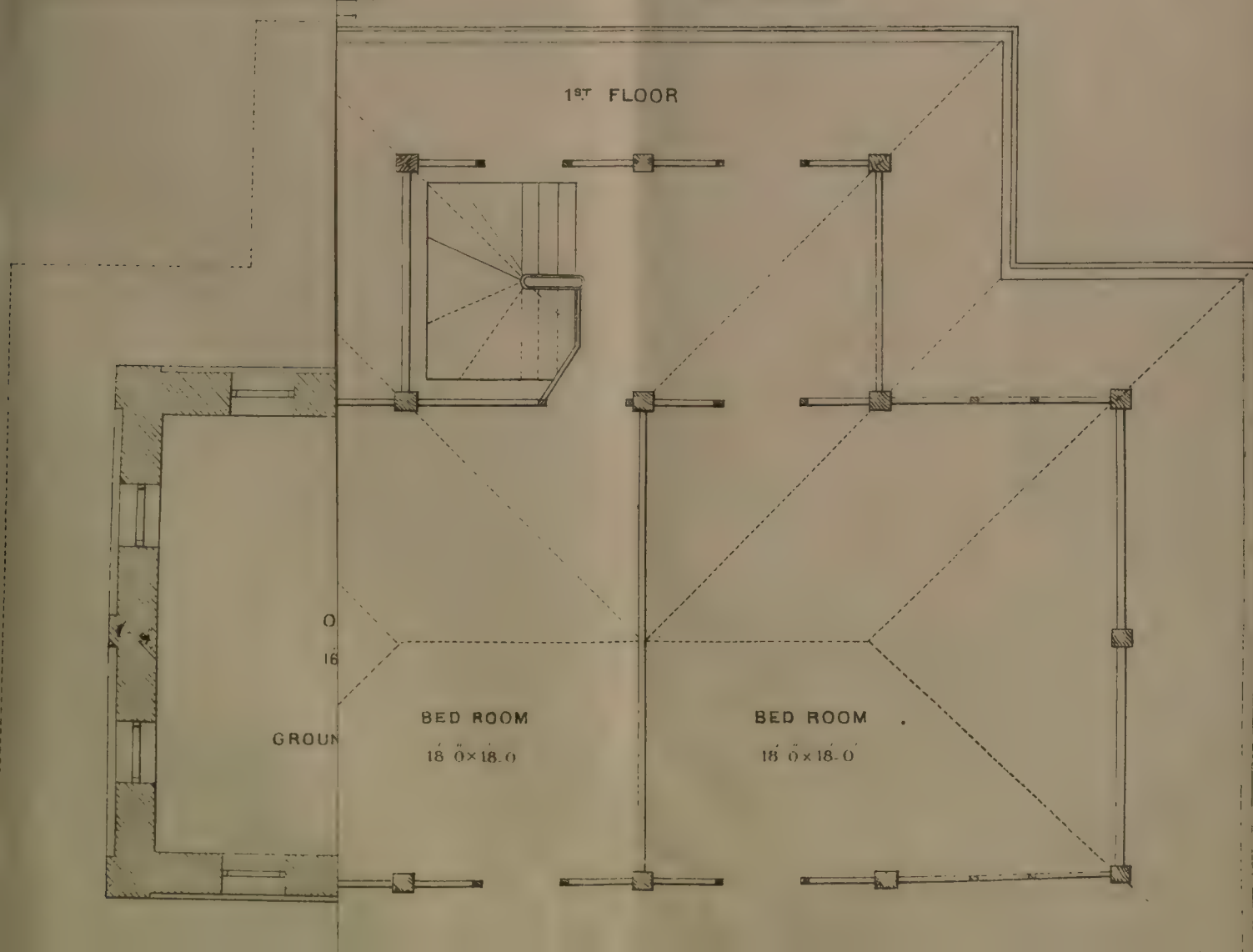
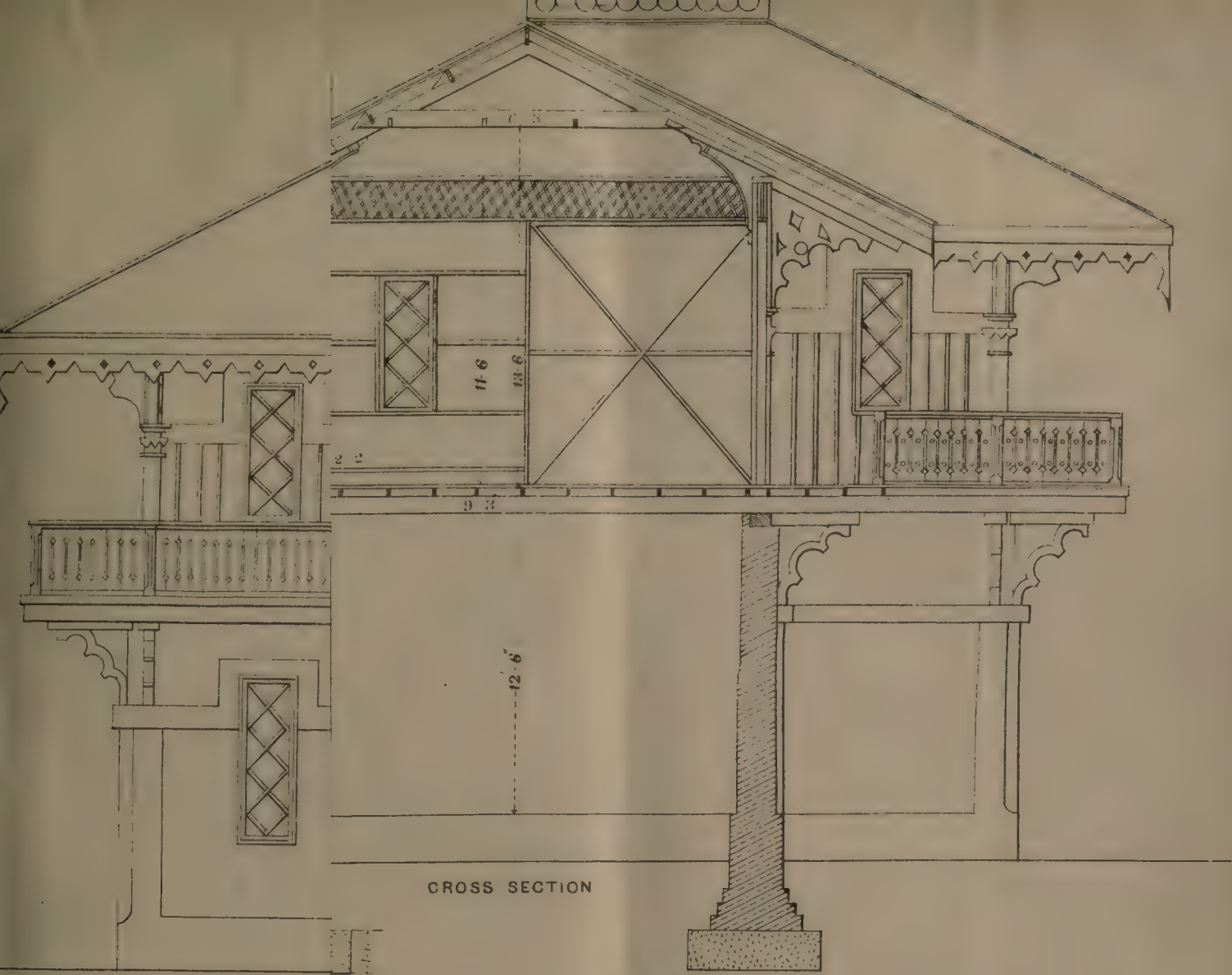
Average monthly rainfall in some towns in the Central Provinces:—

	June	July	Aug.	Sept.	Oct.
Jubbulpore	7.66	18.41	14.12	8.55	1.33
Seoni	9.24	15.44	10.69	8.11	1.37
Nagpur	8.54	12.55	8.40	7.44	1.92

Average monthly rainfall in some towns in Bombay:—

	May	June	July	Aug.	Sept.	Oct.	Nov.
Bombay	0.49	20.33	23.81	12.68	10.22	1.88	0.47
Poona	1.63	6.22	6.75	4.89	4.81	5.29	0.56
Belgani	3.14	9.82	14.29	9.34	2.99	4.43	0.67
Goa	5.65	32.00	28.00	8.10	2.50	6.00	0.15

(To be continued.)

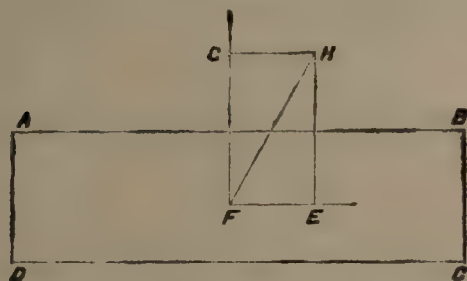


PROPERTIES OF FLUIDS.

By A. EWBANK.

XIII.

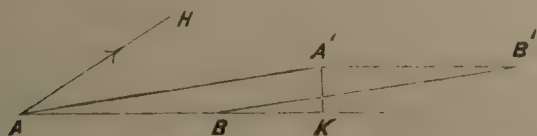
Fig. 38.



In *fig. 38* let the length AB be very great compared with the breadth AD . Let the ends BC , DA be supplied with tapering extremities not shewn in the figure. The force EH may be, in imagination, replaced by the forces EF and EG . The effect of the EG force is to move the body parallel to DA . To this tendency the water opposes a great resistance, because such a motion will disturb a great quantity of water piling up the water along the whole length of AB . To the EF force the water opposes a much less resistance. Therefore the movement which would be caused by the EF component acting separately bears to the movement which would be caused by the EG component acting separately a greater ratio than does EF to EB .

In consequence the real direction of motion of the body under the action of the force EH is not along EH , but in a direction lying between EH and EF . The divergence between the direction EH of the real force, and the direction of the actual movement depends on the shape of the vessel. If we suppose the breadth AD evanescent, the oblique force EH will cause a movement very nearly along EF . If we suppose the body a sphere, or the cylinder already described, the direction of movement will accurately coincide with EH . Between these cases we have that of any ship or steamer.

Fig. 39.



Thus the movement of a ship is such as is indicated in *fig. 39*. Here the line AB may denote a line running through the ship from stern to stem. The ship represented by this median line moves from the position AB to the parallel position $A'B'$. Thus $AA' = BB'$ and AA' or BB' may represent the movement or displacement of the ship. The real force on the ship is denoted by the line AH . This force calls into play a certain horizontal counter force or resistance from the water. If we could estimate this force in magnitude and direction, we should see that the ship was really influenced by two forces, *viz.*, AH and the water resistance. The resultant of these two horizontal forces is the complete force that acts on the ship, and since there is no other horizontal force, the ship must move in the direction of the resultant of these two forces.

The line AB may also denote the direction in which it is desired that the ship should travel. Let $A'K$ be perpendicular to AB or AB produced. Then we may say that whereas the ship is required to move over the distance AK it does in reality move over AK plus a perpendicular distance KA' . This extra or accidental displacement KA' is called leeway. If AB is due East, the ship instead of following the due East course, drifts as it were to the North of East. This drift or leeway can presently be corrected or allowed for by turning the ship's head somewhat to the South of East, so that the ship may ultimately again find herself on the line AB produced. If her head is again pointed due East and the real wind force on the ship continues

to be along AH , the ship will again "make leeway" to the North, and this can again be corrected, and so on.

Fig. 40.

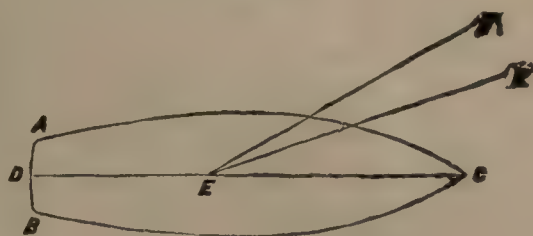
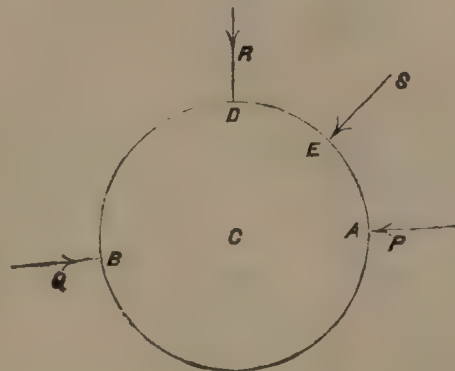


Fig. 15.



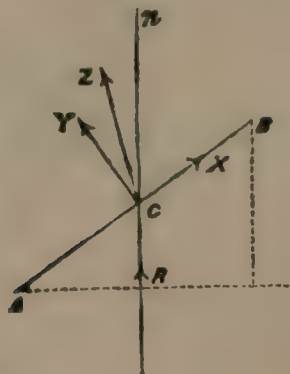
By what precedes we are now able to understand that if a force EH be applied to a vessel shewn in plan by ACB , *fig. 40*, the vessel would move not in the direction EH , but in some other direction EK , which is closer to DC , the midway axial or median line of the vessel. In our reasonings we have assumed that EH is the force which really acts on the vessel. This force might possibly come from wind or it might come from a tow-rope attached to the vessel. If however the force comes from the wind, it is important to notice that EH represents the real force acting on the vessel. It does not necessarily represent the real direction of the wind. We say that EH is the real force on the vessel. This means that a force of equal magnitude and acting along HE would entirely destroy the tendency of the vessel to move. It probably does not seem clear to the reader why we distinguish between the direction of EH the real wind force acting on the vessel, and the direction of the wind itself. If the vessel was cylindrical, as in *fig. 15*, there would be no difference between the direction of the wind itself and the direction of the actual force it exerts on the vessel. Where such a difference does exist it is due to certain peculiarities in the shape of that portion of the vessel which is above the water.

As a simple illustration let us suppose a wind blowing horizontally and due North. Such a wind in English is called a South wind as coming from the South. Let us hold in the hand a hollow cylinder made of paper or some other light material. Let the cylinder have its axis vertical. Let it now be dropped. Instead of sinking vertically it will receive from the wind a northward movement. Suppose next that we hold in the hand an open sheet, *i.e.*, plane sheet of cardboard, or any other stiff, but light material. Let us hold it so that the plane of the sheet is vertical, and is due East and West. In other words, let a line perpendicular to the sheet be due North. If now we drop it we should again see the wind give a northward direction to the sinking body.

Finally let us pick up the open sheet which we suppose still to be flat or to lie in one plane. Let us make its plane vertical, but lying N.-E. and S.-W. In other words, let one face look N.-W. and the opposite face look S.-E. Then if we drop it, we shall see that it begins to move not northward, but in a direction approaching the North-West. It follows that though the actual direction of the wind or the actual movement of each air particle was due North, the cardboard or open sheet received a force which is not exactly northward. For if the force on the sheet be due North, and it is immersed in an air current due North

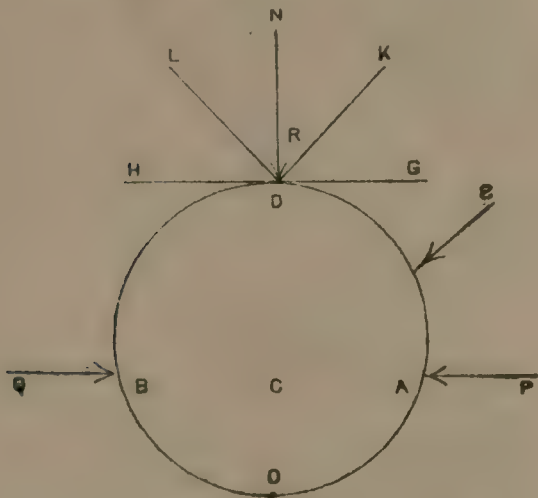
there can be no reason why the sheet should deviate westwards.

Fig. 41.



Let the sheet of cardboard be denoted in *fig. 41* by the horizontal line *AB*. The plane of the sheet will be perpendicular to the plane of the paper. The line *AB* points *N. E.* The effect of the air particles impinging on the sheet is represented by a force *R* due North. This force we replace by a force *X* acting parallel to the sheet, and a force *Y* normal to the sheet. In other words, we replace the northward wind *R*, by two other winds. One of these, *viz.*, *X* strikes the sheet edgewise and has hardly any influence owing to the thinness of the sheet. The other wind *Y* strikes normally and is effective in moving the sheet. The sheet therefore moves nearly in the direction of *Y*. The real force on the sheet is a force *Z*, which is nearly equal to *Y* in magnitude and nearly coincides with *Y* in direction. Thus the wind is here due northward, but the effective wind force is different in direction.

Fig. 26.

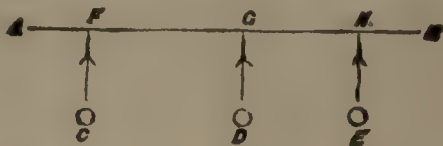


If we propose to replace the real wind force by the tension of a string acting on the stiff cardboard, we must make the string pull, not due North, but parallel to *CZ*. Now in our preceding reasonings, the wind force, which we have supposed to act on the vessel, is that real wind force which we could imagine replaced by the tension of a rope or cable attached to the vessel. We see then that we have, first, the direction in which a wind is blowing; secondly, the direction of the real force it applies to the ship; and thirdly, the direction in which the ship begins to move through the water. If the vessel is a cylinder, as in *fig. 26*, these three directions coincide. If the part immersed is a cylinder, as in *fig. 26*, the two latter directions coincide. Whether the first direction will also coincide, depends on the shape of the ship above water. If the vessel above the water is a cylinder, as in *fig. 26*, the first two directions coincide. Whether the last direction will also coincide depends on the shape of the immersed portions. Generally all three directions are different.

The statement that, as in *fig. 41*, a wind *R* produces

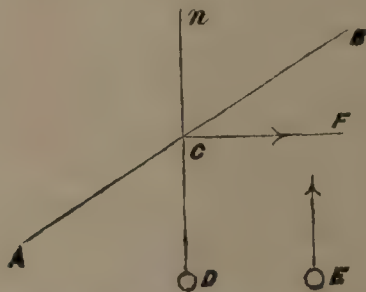
on a body a force *Z* in a different direction, may be considered in another way. By a wind *R* we mean a great number of small air particles impinging on the sheet of cardboard. Now these air particles we will consider to be spherical bodies of very small diameter, though our reasoning will apply whatever be the shapes of these air particles.

Fig. 42.



In *fig. 42* let us have a number of these small air particles moving due North. Let the sheet of cardboard be vertical and due East and West. Then the small particles *C, D, E* striking at points *F, G, H*, &c., will give the sheet a movement parallel to *DG*. The small bodies themselves will receive from the sheet counter blows in directions parallel *GD*.

Fig. 43.



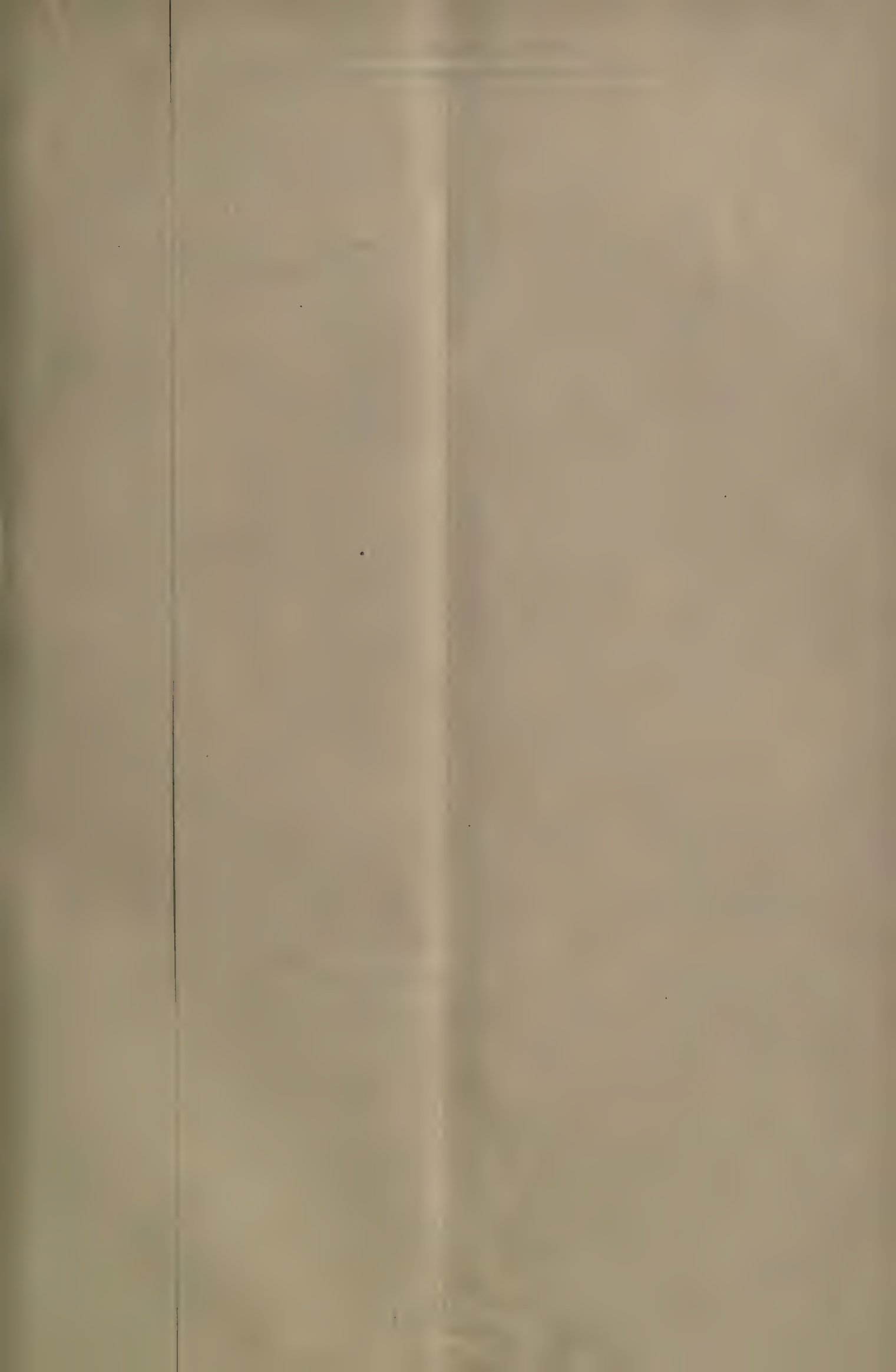
In *fig. 43* we have again small spheres or other bodies *D, E*, &c., moving in lines parallel to *DC*, and striking a sheet *ABC*, which is now oblique to the line *DC*. When the *D* particle has reached *C*, it bounds off in some direction *CF*. This shows that it received from the sheet a blow which was not in the direction *CD*. For a blow along *CD* could not make the little air particle change its line of movement from *DC* to *CF*. In order to make the *D* particle deflect to the East of the line *DCN*, the blow it received from the sheet must have had an easterly component. Conversely the blow which the sheet received from the particle, must have had a westerly component. That is the effect of the impact of the *D* particle on the sheet is not a blow exactly due North, but has a westerly element in it. Thus the cardboard in the case of *fig. 41* is not impelled due North, but more or less in a westerly direction. The cardboard also moves vertically by its weight. We have considered only the horizontal components of the motion.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK XXXI.

PINE plank ceiling $\frac{3}{4}$ " thick, tongued and grooved, and including teak Joists $3" \times 2\frac{1}{2}"$ placed at 3 ft. intervals c to c.

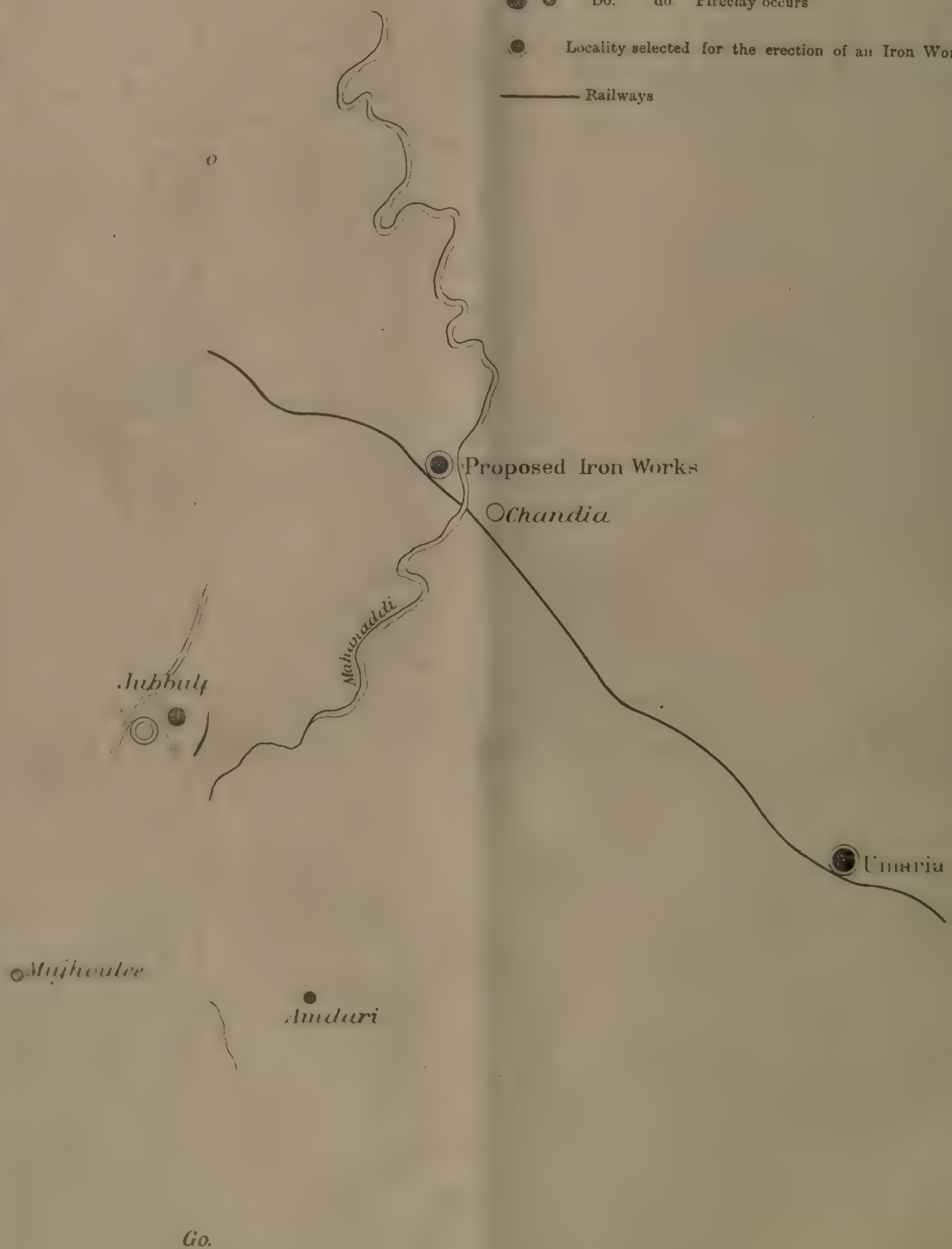
Items per 100 s. ft. (1)	No. or Quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—				
Carpenters No. ...	1½			
Coolies " ...	2			
Sundries				
Materials.—				
Pine Planks $\frac{3}{4}$ " r ft. including Waste ...	215	Variable.	Do.	Do.
Teak wood Joists, c ft....	1'6			
Perforated Zinc Sheets, 8 ft. ...	3'			
Screws or Nails, doz. ...	12			
Sundries				
Petty Establishment				

The pine planks are supposed to be 6" excluding tongue



REFERENCES.

- * Localities where Iron ores occur
- Do. do. Coal occurs
- Do. do. Limestone occurs
- ⊕ Do. do. Manganese occurs
- * Do. do. Fireclay occurs
- Locality selected for the erection of an Iron Work
- Railways



THE MANUFACTURE OF IRON AND STEEL IN INDIA.

VI.

THE iron ores in the neighbourhood of Kutni (Morwara) are numerous and of good quality.

A full description of them has been given by Mallet in his report "On the Iron Ores and Subsidiary Materials for the Manufacture of Iron, in the north-eastern part of the Jubbulpore District."

With reference to the erection of an iron-work, the ores near Bijori (please see Plan No. 2) deserve to be considered first, owing to their good quality and to their situation near the place where an iron-work might suitably be erected.

This deposit of iron ores is situated about seven miles east of Kutni and 31 miles north-west of the Umaria coal-field, and lies also close to the Railway line connecting Kutni with Umaria (please see Map No. 2).

The following is an analysis of the Bijori ore :—

(a.) Ferric oxide ... 81.20 per cent. (or 56.84 per cent. iron.)

(b.) Phosphoric acid ... 1.41

(c.) Sulphur ... traces.

(d.) Loss on ignition... 13.42 "

(e.) Insolubles ... 1.29 "

(f.) Alumina, lime, etc. 2.68 "

This iron ore is "pisolitic lemonite," which is—as wellknown—very easily melted in a blast-furnace.

The 13.42 per cent. "loss on ignition" represents volatile matter which will evaporate in the upper part of the blast-furnace; consequently only 4 per cent. of slag-giving impurities will remain.

The Bijori ore contains a very small percentage of silica, and if worked in a charcoal blast-furnace, a small addition, not alone of limestone, but also of silica, will be necessary to form a blast-furnace slag of a proper com-

position and melting point with the impurities of the ore and the ashes of the charcoal (the latter consisting principally of basic matters.)

For this purpose a ferruginous sandstone occurring close to the work will prove very serviceable; the following is an analysis of it:—

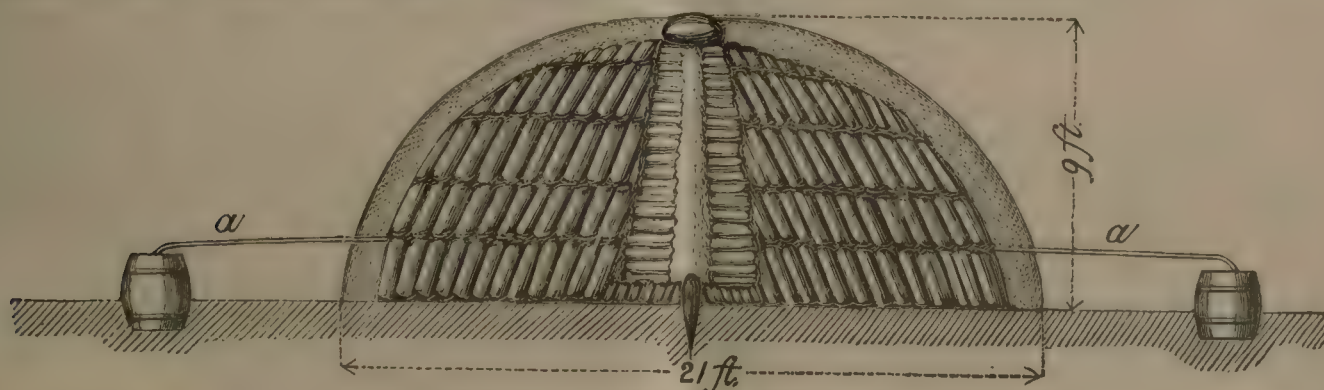
Silica ...	...	55½ per cent.
Alumina ...	...	1 "
Ferric oxide ...	...	38 "
Moisture ...	...	5½ "

For the production of rails the question of supplying "spiegeleisen" and "ferro-manganese" for the Bessemer converter or open hearth furnace will become of importance; for this purpose the manganiferous iron ores at Gosalpore (please see Map No. 2) will be of great value, and could be worked to "spiegeleisen" or "ferro-manganese."

These ores occur 36 miles south of Kutni, close to the East Indian Railway, and can therefore cheaply be brought to the iron-works.

The forests near Jubbulpore and Kutni are well known for their extent and the quality of the wood. They are of a similar character to the other forests in the Central Provinces already described. It may be mentioned that the charcoal prepared by natives of India, although well burnt, is generally in such small pieces that it cannot be considered very suitable for the blast-furnace by this reason. As besides, their method of burning the charcoal is by no means economical—neither with reference to the proper utilization of wood, nor manual labor—it might not be out of place here to draw attention to a simple, though effective, method, of preparing charcoal, practised with great success in France in the iron working countries of Audincourt, Belfort, Bourgignon, &c., which method can easily be learnt by natives.

The pile is made of a conical shape, 21 feet in diameter and 9 feet in height. (Please see Sketch.)



A strong stake is driven into the ground, the top of which is left protruding about 12 inches; around this are placed small pieces of dry wood of a similar length, and standing as close to the upright stake as possible. Another layer is formed in the same manner, and so on, until a circle of about four feet in diameter is obtained. A circle of one foot in diameter (having the top of the stake formerly driven into the ground as the centre) is next made by placing the wood horizontally side by side on the upright pieces, laying others on these in a similar manner, until the pile is of the required height, thus forming a sort of chimney, by means of which the pile is fired; the wood used here being dry pieces of 24 inches in length, but split rather smaller than the ordinary pieces.

Outside this the wood is placed on end and reclining inward, this being continued until the heap is of the required size. The top half of the heap is now carefully examined, and any crevices between the wood are packed full of small pieces of turf and charcoal dust to exclude the air. The heap is then covered with newly cut turf, beginning at the base and working towards the top, each row of turf overlapping by a few inches the previous one; the circular hole or chimney being left open for

firing. The best turf for this purpose is that grown on loamy soil, that from clay being too stiff, and leaving a residuum, after burning, of clods instead of fine soil.

The turf may be cut of any convenient length, but not over a foot in width, the quantity required being about three loads. The heap is next fired by dropping a quantity of burning wood and some dry pieces of soft wood into the opening left at the top.

After having become thoroughly lighted the top turf or a piece of wood is put on, which completely shuts up the chimney when the process of charring commences. During the period of burning, constant attention is required, day and night, more especially should the weather be stormy, for the wind blowing for sometime from one point generally causes that side to burn very rapidly and "flat" into a hole; should this occur, the hole must at once be filled with knotty logs, which should be laid aside for this purpose, when splitting the wood, and re-covered with turf, any crevices being carefully filled with saw-dust or charcoal-dust to exclude the air. During mild weather less attention is required, the pit burns uniformly all over and produces the best charcoal. The time required in burning varies from seven to nine days, much depending on the state of the weather.

mild requiring the longest period. As the charring proceeds the turf gradually disappears, until only a slight covering of burnt earth remains, at which point the pit is reduced to about half its original size.

When cool the pit is ready for opening, the charcoal being extracted by means of a light rake resembling a drag, but with much finer teeth; and after becoming thoroughly cool, is stored in a dry shed until required for use.

If there is no turf available, charcoal-dust, moistened with clay water, can be used for the purpose of covering the heap, as is done in Styria.

a. a are copper tubes leading the products of distillation (wood vinagre, creosot, tar, &c.) into wooden boxes or casks

About 38 miles south-east of Kutni are the Umaria coal-fields.

The coal occurs there in great quantities and is supposed to be of good quality.

The following is an analysis of Umaria coal compared with coal from Warora, C. P., and with Kurhurbaree coal:—

	Umaria Coal	Warora Coal.	Kurhurbaree Coal.
(a.) Fixed Carbon ...	45%	45½ %	63½%
(b.) Combustible volatile matters ...	29%	26%	23½%
(c.) Non-combustible volatile matters (moisture) ...	13%	14%	1 2/2%
(d.) Ashes ...	13%	14½%	12½%

From the above it seems that the Umaria coal is more like Warora coal, which is *not* convertible into coke, principally on account of its small contents of fixed carbon and hydrogen.

It may, however, be assumed that the quality of the coal will improve in the deeper layers by changing moisture and ashes into fixed carbon.

Nevertheless, the analysis shews that the Umaria coal contains a good percentage of combustible volatile matters (chiefly carburetted hydrogen), which will render it, under circumstances, very suitable for use in gas-furnaces for iron-works.

If charcoal is used in the blast-furnace very little limestone will be required as flux, as already mentioned before.

Should, in course of time, coke blast-furnaces be erected, a little more limestone will comparatively be required, owing to the greater percentage of ashes in the coke, containing considerably more siliceous matters than charcoal ashes.

But in both cases the question of supplying sufficient limestone will not become of great importance as long as Bijori iron ore is used, which contains only a small amount of silica, consequently the Kutni limestone, which is of excellent quality, and which occurs quite close to the ores, will cover easily and cheaply all requirements.

The following is an analysis of this limestone:—

Carbonate of lime	... 94½ per cent.
" magnesia	... 3 "
" iron	... ½ "
Insolubles	... 1½ "

The following is the estimated cost of the above mentioned raw materials, per ton, delivered at the place where an iron-work might suitably be erected:—

(a.) Iron-ore	... Rs. 1 12
(b.) Charcoal	... " 10 0
(c.) Coal	... " 4 8
(d.) Limestone	... " 2 8

Fireclay of average good quality occurs close to Jub-

bulpore and near Amdary (please see Plan No. 2) in sufficient quantities.

In case of the basic Bessemer, or the open hearth process being introduced, the question of supplying dolomite for the inner fire-proof lining would arise.

Dolomite, of excellent quality, for this purpose can be had from the marble works near Jubbulpore and, as only small pieces of dolomite would be required, the refuse of the quarries, which can be had cheaply, should be used.

The following is an analysis of this dolomite:—

Carbonate of lime	... 55.48 per cent.
" magnesia	... 43.55 "
Oxide of iron	... 0.36 "
Insolubles	... 0.61 "

The central position of this place (being far away from all the seaports of India) in connection with the high railway freight, prevailing on iron goods in India, will allow a high sale price for iron and steel goods, produced near Kutni, to the neighbouring industrial countries at Jubbulpore, Allahabad, Cawnpore, Agra, &c.

(To be continued.)

NOTES FROM HOME.

(From our own Correspondent.)

THE first section of the Birmingham Cable Tramway has been opened. This section extends from Colmore Row down Snow and Constitution Hills to the Borough Boundary at Hockley Brook, a distance of about 1½ miles. The wire hauling cable is 3½ in. circumference and is composed of six strands of nineteen crucible steel wires having a breaking strain equal to 95 tons to the square inch. At one portion of the line, there is a curve of 45 feet radius on a gradient of 1 in 20, which will severely test the economical working of a cable line. The cars are spoken of as of elegant design and are arranged to carry 40 passengers.

A recent issue of *Engineering* has an illustrated account of the Look Out Mountain inclined Railway, being a paper read before the American Society of Mining Engineers. This is a cable Railway, constructed by Major King, of the United States Engineering Corps, from the base to the summit of Look Out Mountain near Chattanooga, Tennessee. The length of the track is 4,360 feet and the elevation attained is 1,170 or 1 in 3½. The cable used is 1½ inch in diameter and composed of six strands of nineteen wires each. An interesting feature of the work is the simple and ingenious plan establishing telegraphic relations between cars and engine-room, by which either conductor can signal directly to the engineer from any part of the line, whether the car is moving or at a standstill.

Lieutenant-Colonel Findlay, of the Engineer and Railway Volunteer Staff Corps and Associate of the Institution of Civil Engineers, recently delivered a lecture at the School of Military Engineering, Chatham, on the Management and Working of an English Railway, taking as his example the London and North-Western Railway. As this lecture is a complete record of the modern improvements in our Railway working, it will no doubt be found of great value where Railways are established in new countries.

A Bill for the construction of the Metropolitan Outer Circle Railway has just been passed by a select Committee of the House of Commons. The new line which will be eighteen miles long will commence by a junction with the District Railway at Ealing Common and with the Great Western Railway near Ealing, and will pass thence *via* Seedbury, Kingsbury, Hendon, Finchley and Southgate to a junction with the Great Eastern Railway at Tottenham. Short spur lines will also be constructed, so uniting the new line with the Metropolitan and the Great Northern Railways.

It is stated that the London and South-Western Railway are making experiments in compounding Locomotives with Engine No. 446, which has been converted to a compound, the cylinders being 18 inches and 26 inches and stroke 24 inches. The steam pressure being 160 lbs. on the square inch.

At a meeting of the Manchester Association of Engineers a paper was read by Mr. Guthrie on the Thermo-dynamic Analysis of the Gas Engine. In the course of the paper the author described his patent, the chief feature of which is bringing in cool air from the opposite end of the cylinder to that which so far has been universally the practice. In the discussion which followed the question of working with as hot a cylinder as possible was admitted.

The Statistical Atlas of India prepared for the Colonial and Indian Exhibition and published by Ranford, consisting of thirteen maps and diagrams, with descriptive letter press, contains useful information, but the *Athenaeum* says it falls short of what might have been expected from a work of this description.

A further discovery of gold has been made in Wales. It is now stated to have been discovered in Denbighshire Valley known as Naut Clelwyn between Llanermon and Tregeiriog, and mining operations will be at once commenced there. It is stated that there is abundance of water for working the machinery.

The new regulations for the theatres of Madrid have been published. They prohibit the use of gas, and make the adoption of the electric light within six months compulsory. As several new theatres are to be built in London, it would be well if the example set by the Madrid authorities were followed here by those who are responsible for the care of these buildings and the safety of the public.

According to the tables of Mr. Dickenson, it appears that during the month of March only 66 per cent. of the monthly rainfall percolates downwards, as against 78.5 per cent. in February, 70.7 in January, 100 in December and 85 in November. Mr. Bailey Denton, in referring to these figures, points out that, as our rainfall was very deficient in these months, not only of this winter, but also of the preceding winter, and the excess of this March has been composed principally of snow, it follows that, come what may, our springs must be very low this summer.

The British Mékarski Improved Air Engine Company have now some of their Tramway cars running along the Caledonian Road from King's Cross to Holloway. This road is one of the busiest in London. The compressed air cars take their turn with the horse cars, and carry their share of the passenger traffic. By means of stationary engines the air is pumped into reservoirs to a pressure of 450lbs. on the square inch. From the reservoirs the air is, when the car is coupled up to the charging pipes, allowed to pass into reservoirs (similar to those in the engine-house, but smaller) which are carried under the car body. The car is four-wheeled, one pair being used for driving. To the driving wheels a pair of high and low pressure ordinary working cylinders are connected. The first of these is 5½ inch diameter and the second 8 inch diameter. The air in passing to the cylinders passes through boiling water and steam of 60lbs. pressure to the neck. This causes the air to expand and prevents the formation of snow. There are also other advantages claimed for the system. The trial trips were in every way successful.

PROVINCIAL RAILWAYS IN BENGAL.

WHILE Railway extension is being carried on on an extensive scale in all the provinces of India, with the exception of the Bengal-Nagpore line, there is perhaps nothing being done in this province where for want of the means of carriage many parts in the interior are still beyond the reach of the modern advantages of transport, and both trade and agriculture may be said to be existing there in a most inactive state. One who has spent his time in North Bengal, with an observant eye, cannot fail to be struck with the great difference in the material condition of the ryots from what is seen in parts of west Bengal comprising portions of the Districts of Hooghly, Burdwan and Bankurah.

There cannot be a divided opinion on the point that since the opening of the Northern Bengal State Railway a new era has dawned upon that part of the country, both with regard to its progress in trade and agriculture. The old routes of river traffic have been diverted to the Railway, and every Railway station presents the existence of a very brisk trade by the huge heaps of merchandise awaiting despatch. The opening out of the interior of that country by the gradual extension of a system of feeder roads has placed the cultivator in a position totally independent of the neighbouring money lender or grain dealer, who in days gone by did his best to squeeze out as much as possible from the ryot, and left him very little margin for the fruits of his hard toil. He is no longer subject to the schemes of the village usurer, and being within easy reach of the Railway is sure of being able to command the best value for his goods directly they can be brought to the nearest Railway station, where there prevails a very keen competition amongst the merchants. This system of Railways has therefore proved a great boon to the country

through which it has passed, and will continue to extend its blessings by the increased stimulus the people are meeting with from its advantages. This state of affairs presents a most striking contrast to the miserable and backward condition of the people of South-West Bengal, where though land is fertile and the country rich in mineral and jungle products, yet from a sad want of the means of communication and encouragement, the people, poor as they already are, are getting into a gradually worse condition of life. The difficulty of transport which the old primitive bullock cart supplies for the present, has paralyzed trade. Cart traffic again is possible only for the dry months of the year, but it does not pay people to cart merchandize to long distances to reach the E. I. Railway, between which and the country are wide dry rivers such as the Dalkipore and the Damoodah.

During the rains the difficulty is increased; for then, these rivers, bad as they are from the hill torrents of Chota-Nagpore, prove dangerous for navigation, and at the same time, fall so suddenly that they cannot retain water deep enough for the draught of laden boats.

This state of things will continue until improved means of communication are supplied. The extension of the present Tarkessur Railway across the Damoodah to Jehanabad, and from there on in a westerly direction till it joins the Bengal Nagpore line at some point either at Purulia or Raghunathpore passing along its course the towns of Kotulpore, Bishenpore and Bankurah, which apart from their being great centres of trade, are seats of the Civil and Criminal Courts, would meet the need.

That such a line would be paying can be judged from the success which the small bit of the line to Tarkessur has already achieved. This success is said to be mainly due to passenger traffic to and from the shrine at Tarkessur. The extension of the line to the Bengal Nagpore Railway will augment the passenger traffic immensely, as well as develop a large goods traffic.

Beyond the bridging of the two rivers Damoodah and Dalkepur, the construction of the line would not be attended with any Engineering difficulties. The country is generally open and flat, except at the extreme western end; where it is rocky, and not subject to inundation; and as the line would run parallel to that of the fall of the country, any other heavy bridging would not be necessary. Labor is plentiful and building materials are easily obtainable.

RAM NATH BHUTTACHARJEE.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, April 28, 1888.

Lower Burma.

Mr. W. Chadwick, Executive Engineer, 4th grade, temporary rank, Toungoo-Mandalay Extension, Burma State Railway, is granted furlough for 12 months, together with the usual subsidiary leave, with effect from such date as he may avail himself of the same.

Mysore, April 28, 1888.

Mr. B. P. Raghavalu Naidu, Assistant Engineer, having returned on the forenoon of the 21st instant, from the leave granted in Notification, dated 29th March 1887, he is posted to the Tumkur Division. To join at once.

Madras, May 1, 1888.

The following postings are ordered:—

Major A. R. F. Dorward, R.E., Executive Engineer, 2nd grade, will be considered as attached to the office of the Chief Engineer, Public Works Department, from the 13th April 1888, the date of his return to Madras from military duty in Burma.

Captain W. D. Lindley, R.E., Assistant Engineer, 1st grade, to the V. Circle, Presidency Division.

Mr. F. J. Wilson, Executive Engineer 4th grade, temporary rank, is granted furlough for sixteen months from or after 1st July 1888.

Bombay, May 3, 1888.

His Excellency the Right Honorable the Governor in Council is pleased to make the following appointments:—

Mr. J. E. Whiting, M.A., M.Inst.C.E., to act as Chief Engineer for Irrigation and Superintending Engineer, Central Division, with the title of Chief Engineer, Central Division, *vice* Colonel C. A. Goodfellow, V.C., R.E., proceeding on furlough.

Lieutenant-Colonel J. D. Cruickshank, R.E., to act as Superintending Engineer, Southern Division, *vice* Mr. Whiting.

Mr. W. H. LeQuesne to act as Executive Engineer, Nira Canal.

Mr. W. L. S. L. Cameron, Assistant Engineer, 1st grade, is allowed furlough for one year.

Punjab, May 3, 1888.

Lieutenant H. C. I. Birwood, R.E., Assistant Engineer, 2nd grade, from the Dera Ghazi Khan Provincial Division to the Peshawar Provincial Division.

India, May 5, 1888.

Mr. T. English, Honorary Assistant Engineer, 3rd grade, Central Provinces, is transferred temporarily to the Simla Imperial Circle.

Mr. P. R. Langley, Sub-Engineer, 1st grade, State Railways, is granted the honorary rank of Assistant Engineer.

The undermentioned passed students of the Thomason College are appointed to the Public Works Department as Apprentice Engineers, and posted as follows :

Burma.

Mr. V. C. French.

Assam.

Mr. W. E. Knight.

State Railways.

Mr. H. W. Perry

Mr. J. Eaglesome.

Messrs. H. W. Perry and J. Eaglesome, Apprentice Engineers, are posted to the establishment under the Director-General of Railways.

The services of Mr. W. E. Meares, Executive Engineer, 3rd grade, North-Western Provinces and Oudh, are placed at the disposal of the Government of Madras for employment on the South Indian Railway.

The Governor-General in Council is pleased to order the following promotions and reversion of Executive and Assistant Engineers attached to the several Local Administrations, with effect from the dates specified :

Mr. J. B. Leventhorpe, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 4th grade, permanent, from 1st November 1887.

Mr. C. O. Leefe, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.* from 1st November 1887.

Mr. H. R. F. Ash, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary, from 1st November, 1887.

Mr. H. G. Billings, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, permanent, from 1st November, 1887.

Mr. R. D. Buck, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary, from 30th January 1888.

Mr. R. H. Tickell, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary, from 1st February 1888.

Rao Dhondoo, Sakharam Sathaye, Sahib, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary, from 2nd February 1888.

Rao Dhondoo, Sakharam Sathaye, Sahib, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, temporary, from 20th February 1888.

Rao Dhondoo, Sakharam Sahathye, Sahib, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary, from 20th March 1888.

Major F. Firebrace, R.E., Consulting Engineer for Railways, Bombay, and Joint Secretary to the Government of Bombay in the Railway Department, is granted six months' special leave.

Major B. A. Sargeant, R.E., Class I., 1st grade, temporary rank of the Superior Revenue Establishment of State Railways, is appointed to officiate as Consulting Engineer for Railways, Bombay, during the absence of Major Firebrace, R.E., on special leave, or until further orders.

N. W. P. and Oudh, May 5, 1888.

Irrigation Branch.

In anticipation of the approval of the Government of India, Mr. J. S. Beresford, Executive Engineer, 1st grade, is appointed to officiate as Superintending Engineer during the absence of Mr. A. J. Hughes on privilege leave, and is posted to the charge of the II. Circle, Irrigation Works, *vice* Major F. V. Corbett, R.E., transferred to the III. Circle. Major Corbett made over and Mr. Beresford received charge on the forenoon of the 25th April 1888.

Mr. J. S. Beresford, Executive Engineer, 1st grade, was attached to the Chief Engineer's office on special duty from the 16th to the 24th April 1888, inclusive.

Major F. V. Corbett, R.E., is transferred from the II. to the charge of the III. Circle, Irrigation Works, during the absence of Mr. Hughes on privilege leave, or until further orders. Mr. Hughes made over and Major Corbett received charge on the forenoon of the 25th April 1888.

Buildings and Roads Branch.

With reference to Railway Branch Notification, dated 24th April 1888, Mr. W. G. Wood, Assistant Engineer, 1st grade, is posted to the Gonda district as District Engineer, *vice* Mr. G. C. F. Barnardo, Executive Engineer.

Mr. H. H. Roden, Assistant Engineer, 1st grade, District Engineer, Jhansi, is granted furlough for one year and six months, with effect from such date as he may be relieved of his duties.

Railway Branch.

The services of Mr. W. G. Wood, Assistant Engineer, 1st grade, Lucknow-Sitapur Railway, are replaced at the disposal of the Buildings and Roads Branch.

Mr. W. G. Wood, Assistant Engineer, 1st grade, Lucknow-Sitapur, and Seramau Railway, passed the Departmental Standard Examination in Hindustani on the 2nd April 1888.

Irrigation Branch.

Colonel E. C. Garstin, Executive Engineer, 1st grade, from the Hansi Division, Western Jumna Canal, which he left on the forenoon of the 1st April 1888, to the Patiala Division, Sirhind Canal, which he joined on the forenoon of the 9th April 1888.

Colonel Garstin, took over charge of the Patiala Division, Sirhind Canal, and of the Canal Agency Office from Major S. L. Jacob, R.E., on the afternoon of the 17th April 1888.

Major S. L. Jacob, R.E., Executive Engineer, 1st grade, from the Patiala Division, Sirhind Canal, which he left on the afternoon of the 17th April 1888, to the Office of Superintending Engineer, Sirhind Canal Circle, of which he took over charge from Mr. T. Higham, Superintending Engineer, on the forenoon of the 18th April 1888.

Assam, May 5, 1888.

Furlough for nine months together with the necessary subsidiary leave, is granted to Mr. R. E. Nelson, Executive-Engineer, Second grade, and District Engineer, Goalpara, with effect from 3rd July 1888, or such subsequent date on which he may avail himself of the same.

Rai Sahib Brij Mohonlal, B. A., Assistant-Engineer, First grade, is appointed to officiate as District Engineer, Goalpara, during the absence on furlough of Mr. R. E. Nelson, or until further orders.

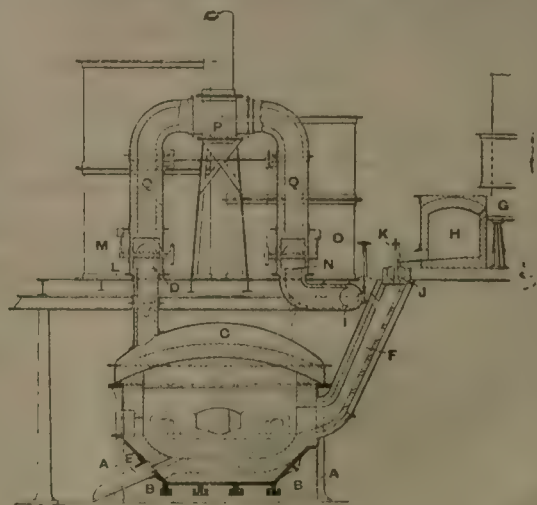
Bengal, May 9, 1888.

Mr. J. P. Cleghorn, Executive Engineer, is, on return from leave, posted to the Office of the Superintending Engineer, Eastern Circle, as a temporary arrangement.

Indian Engineering Patent Register.

RECENT BRITISH PATENTS.

MANUFACTURE OF STEEL.—*B. H. Thwaite, Liverpool, and J. Noble, Middlesbrough.*—This invention introduces certain improvements into the process described in Patent No. 11972 of 1886, granted to B. H. Thwaite. The molten metal from the blast furnace is run direct to a receiver. After a sufficient quantity is accumulated, it is tapped into the ladle, which runs on rails on an upper floor. This upper floor is built at such a height above the open hearth furnace as to be level with the upper end of a Thwaite vertical pneumatic converter placed on the centre of the furnace roof. Open hearth recuperator vessels are placed on this upper floor. The melted pig is run from the ladle into the Thwaite converter, in its course through which it is partially converted by the air blast. The bath of the open hearth furnace is made shallow, so that a large surface of metal is exposed. When phosphoric pig iron is employed, a preliminary basic open hearth and inclined furnace is substituted for the basic cupola. The inclined hearth furnace has several levels, on which the pig iron can be rapidly charged and melted. A finely ground limestone is there added to the metal, in order to increase the basic character of the slag. A recuperative arrangement is provided in this inclined furnace for the removal of the phosphoric element; and a second furnace of



silicious material afterwards receives the metal in its pure state. The inventors specify several arrangements of plant for carrying out this process, one of which is illustrated in vertical section in the accompanying diagram. The furnace is made circular in plan; its under side is surrounded by a casing A, enclosing an air space B. This air space is connected with another at C, which in its turn is connected to the air reversing valve D, so that the heat radiated from the side of the furnace is utilised by being re-added to the internal heat of the furnace. The tapping spout is shown at E. The Thwaite converter at F, the cupola at G, and the receiver at H. The upper part of the converter communicates with the gas supply flue I, so that it can be

heated to a high temperature before the metal is tapped from the receiver H. The air to support the combustion of the gaseous fuel in the converter passes through the metal ingress J, which can be entirely covered with a fire clay plug K. The reversing valve arrangement is placed on the upper floor; L is the air valve connected to the air recuperator vessel M, and the gas valve N communicates with the gas recuperator O. The valves are connected to the chimney flue junction P by means of the lined flues Q. The inventors make five claims for the process and the plant described.—No. 16497. December 1st, 1887.

In the matter of the Indian Companies Act, 1882.

AND

In the matter of the Deoghur Mining Company, Ltd. FOR SALE.

THE mining and other rights of the above Company in Mouzahs Toolsitar, Loth Bedooa, Churkidangi, Bissenpore, and Mongua Reidee, in Talook Ropinee in the Sub-district of Deoghur, in the Sonthal Pergunnahs, comprising 6,057 biggahs, or thereabouts, under a lease, dated the 29th May 1883, for 149 years from 29th May 1883, and as to Mouzahs Toolsitar and Churkidangi under conveyances from the Mustagirs thereof respectively.

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DIGNAM, ROBINSON & SPARKES,

*Attorneys for the Liquidator
of the abovenamed Company.*

4, STRAND, CALCUTTA; }
24th April 1888.

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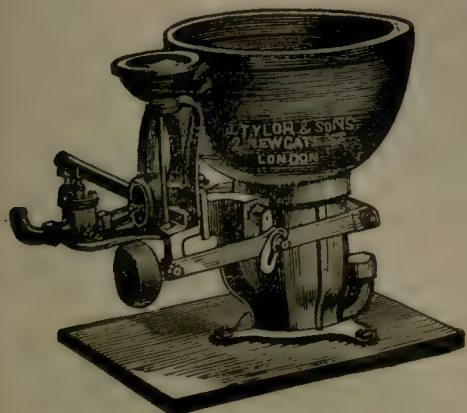
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NOTICE.

Bengal-Nagpur Railway.

1st. Sealed tenders for the supply of 30,000 cubic feet of teakwood scantlings required for the construction of Broad Gauge Railway Carriages in the Nagpur Workshops, B.-N. Railway, will be received by the Agent up to noon of the 30th May and will be opened by him then and there in the presence of all parties who may choose to attend.

2nd. The timber to be seasoned and sound, cut perfectly straight and square to be free from knots, flaws or cracks. Sizes of scantlings, and terms and conditions of tender along with form of tender may be obtained from Locomotive and Carriage Superintendent, B.-N. Railway, Nagpur.

3rd. Seals of tenderers unable to write will not be accepted; they should have their marks verified by witnesses.

4th. Covers to be superscribed "Tender for Teakwood scantlings for Bengal-Nagpur Railway."

5th. The tender may be in part or for whole requirement and the Agent reserves to himself the right to accept in whole or in part, but in the event of his accepting in part only, and the tenderer failing to take up the contract, the whole earnest deposit will be confiscated.

6th. Tenders without earnest money of Rs. 1,000 will not be attended to.

7th. The Agent reserves to himself the power of rejecting any tender without assigning a reason, and does not bind himself to accept the lowest or any tender.

NAGPUR; } (115)
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T. R. WYNNE,
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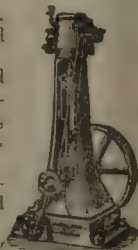
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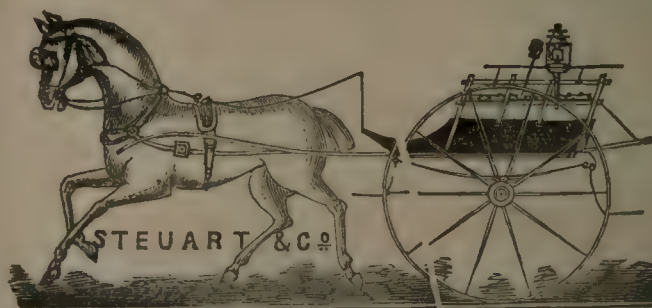
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Obituary.

GARDNER.—Accidentally drowned on May 1, 1888, by the sinking of a steam launch in the River Hooghly, Alexander Gardner, Foreman Engineer, Messrs. Burn and Company, Howrah Iron Works (late of Khangaum, West Bera H. A. D.)

INDIAN ENGINEERING.

SATURDAY, MAY 19, 1888.

JEYPUR GAS WORKS.

If all the chief towns in the Independent Native States received the same attention from their rulers as Jeypur, the capital of the model principality in all India, it would be a matter for congratulation not only to the Feudatory Princes, but also to the Paramount Power. Visitors to Jeypur cannot help being struck with the real, substantial improvements which have been inaugurated there within the last few years, while other princes have squandered fabulous sums in securing their personal comforts or in useless displays. Jeypur has always taken the lead in studying the conveniences of its subjects and ministering to their wants. This is nowhere more apparent than in works of public utility which abound in that place, and of which gas forms a prominent feature. We have before us two reports on the oil gas works, separated by several years, one for 1880 when the scheme had just been introduced, and the other for 1887. The total cost of these works was about Rs. 3,17,822, and for the first six months of the Raj official year, that is from September 1879 to March 1880, the cost of the materials used was C.Rs. 23-2-5 per 1,000 cubic feet, but if the establishment be included, the cost comes up to C.Rs. 29-7-8 per 1,000 cubic feet.

It was about this time Mr. Tellery, an expert and a most energetic officer, was placed in independent charge of the gas works, and he managed to effect a great saving, for in the next six months, that is from the 1st March 1880 to 1st September 1880, he managed to reduce the cost of manufacture from Rs. 23-2-5 to Rs. 18-1-8 per 1,000 cubic feet. During the first six months the total gas produced was 672,771 cubic feet, and during the last six months 511,873 cubic feet. This is accounted for by the fact that owing to the shortness of nights in the summer a smaller quantity of gas was consumed. The gas is produced chiefly from castor oil, but other oils, such as poppy, til, and rapeseed are also used, when the former is not available, or when the latter can be had at more favorable rates.

Mr. Tellery says :—" According to my own records and experiments, I generate 26½-candle strong (tested by a burner using 2 cubic feet per hour) light when from one maund of castor oil 750 cubic feet is produced, and 18½-candle strong light when 1,000 cubic feet is produced, and 9-candle strong light when 1,250 cubic feet gas is produced from one maund castor oil. If other oils are used, 610 cubic feet in the first, 762 cubic feet in the second, and 914 cubic feet in the third of above instances. According to these experiments, and the present price of oils (1880), as they are supplied to the gas works, castor oil at Rs. 11-12, other oils at Rs. 10 per maund, the gas generated from castor oil comes to Rs. 0-10-4 cheaper per each 1,000 cubic feet than when generated from other oils."

The apparatus used is Professor H. Hirzel's patent, Leibzig Germany. The works consist of two separate sets, with,

one gas holder for each set. The two gas holders contain 15,240 cubic feet. If both sets are worked 2,000 cubic feet of gas are generated every working hour. The following is the process of manufacturing :—The retorts have to be heated from 6 to 8 hours, by which time they are sufficiently heated to decompose the oil and generate gas. Then the oil is passed into another retort through a syphon, and must be carefully watched so that no more oil shall enter than the heat of the retort is able to decompose instantly. If less oil enters then the retorts get overheated, and the heat produces a larger volume of gas but of inferior quality, because the olefiant gas thereby deposits one-half of its carbon, and is converted into common carburetted hydrogen. As soon as gas begins to escape from the heated retort, tar and ammoniacal vapours are deposited in a hydraulic cylinder. The gas still retains a considerable portion of tarry and ammoniacal vapours which must be immediately extracted, otherwise the tar would pollute the lime, sulphate of copper and iron in the purifier, and interfere with its purification. Therefore to favor the action of the latter the gas is conducted from the hydraulic cylinder through a tube into a square vessel to cool down, from this the refrigerated gas passes into two large cylindrical vessels which are filled with large pieces of coke. From here the gas is passed into the purifier, which is filled with a mixture of dry lime, sulphate of iron and copper, sheep's wool saturated in naphtha and saw-dust, from where it is passed in a purified state to the gas holder. The hydraulic oil press is of English manufacture. The whole consists of one hydraulic pump, two presses, two seed crushers (one for castor oil and the other for other oil seeds), one heavy stone mill, one heating pan, one copper vessel for clarifying the oil, and one gearing of three horse-power. The total expenditure incurred by the gas works for the year ending December 1887 was Rs. 66,601, revenues collected Rs. 7,578, the total amount actually spent was therefore Rs. 59,022.

Mr. Tellery has on several occasions proposed to the Maharajah to give more facilities to private consumers of gas which would bring in handsome returns and the works could be made a paying concern, but the Durbar has not approved of the proposal. Mr. Tellery very pertinently observes :—As long as the gas works are not managed with an eye to business, the revenue must remain nominal, as it is now. In 1887 the cost of gas per 1,000 cubic feet was Rs. 8-9 against Rs. 8-15 in 1886. The total quantity of gas produced during the last year was 2,858,040 cubic feet compared to 2,466,940 in 1886. The amount expended on original works was Rs. 24,178. We earnestly recommend all the larger Municipalities throughout India to take a note of these reports, and consider how far they could follow in the footsteps of the Jeypur Durbar in the matter of introducing oil gas within their jurisdiction.

To Test Wood.—This recipe comes from Frankfort the headquarters of an extensive timber trade, and may we suppose be relied upon :—To test wood whether it is well seasoned, put a small quantity of tincture of Iodine on a part freshly sawn or cut. If it assumes a dark nearly ink colour then the wood is good and at least one year cut ; but if the place assumes a yellow colour then the wood is quite new and not fit to use.

BANNU RAILWAY SURVEYS.

THE Bannu Railway Surveys are now nearly completed. Three routes were ordered by the Government of India to be surveyed to connect Bannu with the Sind Sagar Railway System.

The first starting from Durya Khan a Station on the Sind Sagar Railway, crosses the River Indus to Dera Ismail Khan, thence *via* the Pezu Pass, at the foot of the Sheikh Budin Hills, across the Gambila River, and on in a fairly straight line to Bannu. The country is easy, except for a length of some 10 miles at the Pezu Pass where will be some heavy works in soft sandstone on grades of 1 in 100. The largest bridge is that across the Gambila River which is about $\frac{1}{3}$ rd of a mile wide.

The most important problem to be solved, however, is the best means of working the traffic at all seasons of the year between Durya Khan and Dera Ismail Khan, as the width of the Indus from high bank to high bank, is some 15 miles within which the main stream meanders. In the cold weather, the main channel is crossed by a long bridge of boats, and there are a number of side channels crossed in the same way, but for a month or two in the flood season, nearly the whole width of the river bed is more or less covered with water, and it takes from 10 to 14 hours, and even longer to get from Durya Khan to Dera Ismail Khan. The length from Durya Khan to Bannu is about 105 miles.

The second route surveyed, is from Koondian a station on the Sind Sagar Railway *via* Mianwali to Kalabagh, where the Indus is crossed, thence down the right bank of the river past Esa Khel, then bending west it crosses the River Kurram which is some 1,500 feet wide, and on past Laki to join the route from Dera Ismail Khan south of the crossing of the River Gambila. The country along this route is generally easy, with but occasional short lengths of 1 in 100 and the work is very light.

The River Indus at Kalabagh is confined between high rocky, well defined banks, and is but little more than $\frac{1}{3}$ rd of a mile wide. The native boat ferry works all the year round, and a steam ferry can very readily be established whenever required. Passage across the river here at high flood never takes more than about an hour. The distance to Bannu by this route, is about 105 miles.

The third route surveyed, was to find a more direct line from Kalabagh across the hills to Bannu.

This route presents very many serious difficulties as the hills are very high and precipitous, necessitating steep gradients with heavy works, and the drainage to be crossed is very extensive, requiring expensive bridging.

In addition to these the alignment for a military road has been pegged out between Kalabagh and Lachee a village some 20 miles west of Kohat. This is about 45 miles long over a very rough country necessitating expensive works. The staff has also surveyed an alternative route for the proposed line to Khushalgarh along the banks of the Indus. They are also now engaged getting up the plans, sections and estimates, which will probably be submitted to Government about the end of September.

THE BUILDING SECTIONS OF THE NEW MUNICIPAL BILL.

"It is an ill wind that blows nobody good" is a saying which has special reference to the late disaster in Kyd Street. Whatever may be the result of the enquiry now being carried on by the Coroner, or whoever may be held primarily responsible for the loss of so many lives, one thing is plain enough, that the Municipality has been aroused from their slumber to a sense of duty in the matter of permitting dilapidated houses to encumber the city by their presence, and thus becoming a source of danger to Her Majesty's subjects. The lucid and admirable official report of Mr. Kimber on the catastrophe, attributes it to the rotten condition and faulty construction of the walls. "The terrace roof and floors of the building," it goes on to say, "were of fair materials, but the walls generally from basement to roof were most unsubstantial, being for the most part of small bricks, pieces of bricks, wretched mortar and no bond." If to this be added the removal of the cross wall on the middle flat, and the conversion of two rooms into one running the whole length of the house, the accident may fairly well be accounted for. It is not our purpose, however, to moralize on the accident, but merely to show what must be done to prevent such accidents in future. It appears that the Corporation has taken the opinion of their legal advisers, who think that as the Municipal Act stands at present, it does not impose on it any "legal obligation to institute inquisitorial proceedings with a view of ascertaining whether any buildings which are away from a thoroughfare are safe or not, nor is any such obligation imposed on local authorities in England by the Towns Improvement Causes Act 1847, from Section 75 of which Section 266 of the Calcutta Municipal Act is taken. We take it, however, that the Corporation would be bound on receiving information that a building was unsafe to depute a proper officer to enquire into the matter, and to take action under Section 266 if necessary, and also that steps should be taken by a proper officer to see that buildings abutting on a thoroughfare are not allowed to be in a dangerous state, and this we understand is done. The dangerous houses which exist in Calcutta, and there are many in as bad a condition as was No. 11, Kyd Street, would give full employment to a department if the Municipality were to be invested with inquisitorial power concerning them."

From a perusal of the above it is quite apparent that the existence of 'dangerous' houses in Calcutta is admittedly taken for granted, and such is the fact. But whether the Municipality is bound to institute an enquiry into their condition of their own will without having its attention drawn to them, is another matter. We think the legislature was perfectly right in withholding the inquisitorial power concerning such houses; for a simple reason that the public whose interests are affected would be careful to bring the matter to the notice of the Corporation. In a recent newspaper report of the debate in the Bengal Legislative Council of the new Calcutta Municipal Consolidation Bill, Sir Henry Harrison intimated to

his colleagues that he would invite a discussion on its provisions relating to the inspection of dilapidated houses, and if they considered it necessary, to amend certain sections. Since then we have heard nothing more on the subject.

We intend here reviewing those sections of the Bill regarding their applicability to the present needs and requirements of the town. Under Section 233 "if any building or any thing affixed thereon, be deemed to be in a ruinous state, or likely to fall, or to be in any way dangerous," the Commissioners shall give notice in writing to its owner or occupier to take down, repair, or secure such building, and in the event of their failure to do so within three days after the notice, the Commissioners may do the needful and the expenses should be paid by the owner. Should the premises which have been taken, be found to project beyond the regular line of a public street, or beyond the front of the house on either side of it, the Commissioners may require it to be set back towards the regular line of the street, giving full compensation to the owner of the house for any direct damage he may thereby sustain. In the case of any new house to be built, a plan must be submitted to the Municipality, and other particulars given which will be considered by the Corporation and the necessary orders passed thereon. We are glad to see for the first time in the history of the Calcutta Municipality that some stress is laid on the mode of drainage, means of water-supply and of ventilation. Here is the thin end of the wedge and as time rolls on, other precautionary measures will be taken to render the air and water as pure and wholesome as possible. Should the Bill be passed into law we have no doubt that in course of time, Calcutta, especially the Northern Division, will present a cheerful sight and the irregular appearance of streets and lanes upon which houses of every description obtrude themselves now, will have been an institution of the past; and with their removal there will be more room for sanitary improvements. The Commissioners insist that the plans should be prepared by a competent Surveyor so as to give them the stamp of professional authority.

There is, however, one portion of the Bill to which we cannot help taking exception, and that is, the penalty clause. The Commissioners are empowered to demolish the building that may be commenced without certain formalities being gone through in taking their permission. This is so far so good, but when in addition to this they are armed with the authority to inflict a fine of Rs. 100 on any recalcitrant house-owner, and to continue it at the rate of Rs. 20 a day during which the offence has been committed, we think that a great deal of hardship is involved by such a proceeding. It will, of course, be said that he has infringed the law and must pay the penalty imposed by it; we are in justice bound to state that the destruction of his property is a sufficient punishment, and the law should not be permitted to impose a heavier loss than the circumstances of the case demand. It is a general principle recognised in Jurisprudence that the penalty should be commensurate with the offence; but in this instance it is out of all proportion to the guilt,

if any, of the owner of the house. If such a provision was enacted in the instance of a proprietor failing to break down a house which was in a dangerous condition, we might be prepared to agree with the legislature, but as it is contemplated to punish a man who has already suffered a loss, we are bound to enter a protest against the dual penalty. The inequity of the proceeding is still more marked in the case where compensation is required to be given to a person who wishes to build a house, but who has not received any answer from the Commissioners to his application for permission to do so, within the prescribed period of thirty days from the receipt of the application. The party so aggrieved will receive a compensation of one rupee per diem for each day in excess of thirty days. If he certifies that the building will cost Rs. 10,000, Rs. 25,000, Rs. 50,000 and Rs. 1,00,000 then the compensation will be increased to Rs. 2, Rs. 5, Rs. 10 or Rs. 20 per diem respectively. Comment on the above is superfluous. One remarkable feature of this piece of legislation is the general wish of the Council to introduce as much of comfort, air and light into new buildings as they can, without at the same time interfering with the rights of the owners. With this object in view, the minutest details regarding the levels and width of foundation, the height of the plinth, the arrangement of the latrines and adequate ventilation of the premises, are insisted upon, and here the Commissioners carry with them the sympathy of all men who have at heart the welfare of the city. We hope to notice the regulations about the building of huts and *bustees* in a future issue.

PROPERTIES OF CEMENTS.—The following points call attention to the waste of money resulting from the incomplete knowledge of the properties of cements. Some Engineers spend money to test their cement, yet the mortar used in their works is not worth a penny. Good cement should be bought, but good mortar should be made with it. The summarised results subjoined cannot fail to be of practical use to Engineers in charge of masonry work with a view of avoiding the common, so-called, tests of no value whatever :—

1. If masonry work is made under contract, the specifications should state the required properties of the mortar and *not of the cement*. A cement may give splendid results when tested neat, and yet the mortar may be of the poorest kind. *Tests of pure cement alone are entirely useless.*

2. When the object is to determine the relative value of different brands of cement, tests should be made with different proportions of sand in order to ascertain which is the *most economical* cement.

3. These tests should be made under similar conditions: the temperature, the manipulation, the quality of sand, the speed and uniformity in applying the load, etc., are all important factors. *They should be constant*: otherwise the results will not be reliable.

4. The compressive strength is of the greatest importance in ordinary construction; unfortunately it cannot be ascertained with any degree of accuracy. The cement is *injured before it is crushed*.

5. It was observed that an expansion of 4 per cent. was taking place in a cement pavement; it was due to the hydration of magnesia contained in excess in the cement. Some mortar should be placed in a glass tube and some water poured on top; if the glass breaks, the cement is *unfit for work exposed to dampness*, and should be analyzed.

Notes and Comments.

THE COLLIERIES.—Cholera is raging in, round, and about the collieries. Mr. G. H. Hamilton, formerly Manager of the Khandwa Iron Works, has fallen a victim to the disease.

MORE COAL IN ASSAM.—We learn that an expert is now reporting on coal-fields in Assam, which bid fair to become very powerful rivals of the Makum—if not in respect to the quality of their production, at least in their proximity to the centres of demand.

PROGRESS IN INDO-CHINA.—A telegraph line has been laid between Phuyen and Khan Hoa. Telegraphic communication by land from Tonquin to Annam is thereby complete. The completion of the telegraphic network may be expected to give an impetus to trade.

KIDDERPORE DOCKS.—It is rumored that Mr. J. H. Apjohn, the Superintending Engineer, Calcutta Port Improvements, intends taking three months' privilege leave, and that such absence will not necessitate the appointment of a *locum tenens* in charge of the works.

THE MADRAS HARBOR.—It will not surprise many to learn that Mr. Thorowgood, Superintendent of the Madras Harbor Works, who has not been able to agree with the Harbor Trust Board as to the freedom of action he should be allowed, has resigned. We can only say—the pity of it!

A CHANGE FOR THE BETTER.—It is rumored that Mr. J. W. Buyers, Engineer-in-Chief of the Burma State Railway, is likely to be one of the Superintending Engineers of the Province after the Mandalay Extension is completed, and that Mr. H. Rigg will be Manager of the Railway.

BENGAL COAL INTERNAL EXPORT.—This article shews a decrease of 3,86,665 maunds on the returns of the quarter ending the 31st December 1886. The decrease was principally due to absence of demand from foreign railways. By far the largest falling off occurred in the despatches from Giridih.

SEEBPORE ENGINEERING COLLEGE.—The Committee for the reorganization of this Institution would appear to have come to loggerheads regarding their final report, and a new one is under preparation, which will, it is believed, be a correct exponent of the suggestions offered as a result of the inquiry.

P. W. D. SECRETARYSHIP, BENGAL.—It is unquestionable that one man cannot perform the work of Secretary and Joint Secretary for long in an important Province like Bengal, and there appears to be a consensus of opinion that Mr. E. J. Martin will soon be appointed to fill the vacant Chief Engineership in the Province.

A LARGE DIVIDEND !—The 28th report of the Directors of the Nerbudda Coal and Iron Company (Limited) for the year ended 31st December states that, after providing for debenture interest and income tax (England and India), there is a profit balance of £2,790: out of which the Directors recommend a dividend of 1s. per share, leaving £308 to be carried forward.

NEW HIGH COURT BUILDINGS, MADRAS.—On the requisition of Mr. J. W. Brassington, Consulting Architect to the Government of Madras, the estimate, amounting to Rs. 1,44,131, for the preparation and collection of materials required for the new High Court buildings, is sanctioned. A sum of Rs. 2,15,000 has been provided for the buildings in the Provincial budget for 1888-89.

PUBLIC WORKS IN JAPAN.—The Budget of Japan for the fiscal year 1888-89 shews a proposed expenditure of a million and a half dollars on engineering works; four millions and a half on the department of communications, including nearly one million for steamship subsidies; two millions for the *Hokkaido-cho*, or colonial board; one million on forts and coast defences; and the remaining two millions on the senate, auditors, railways, building a palace for the Mikado, exhibitions, &c., &c.

THE RED RIVER, TONQUIN.—Now that the higher reaches of the river have been discovered to be impassable to the smallest steamers, it behoves the Government of India to push on as rapidly as possible the work of land inter-communication between Burma and China. The expectations of enthusiastic Frenchmen to bring the trade of Western China to the feet of France are therefore doomed to disappointment, seeing that the river is only navigable as far as Haoha.

BREACH OF FAITH.—Discontent appears prevalent in the ranks of the temporary upper subordinate establishment employed in Upper Burma, as several of them were engaged on the understanding that if they gave satisfaction they would likely become permanent. They were recommended for permanent appointment by their immediate superiors, but it would appear the Government of India would not sanction the proposal so long as permanent men were available in other provinces.

"MINING ENTERPRISE IN CHINA."—The reduction and smelting works of the Tamchow and Tai-yu-shan Mining Company were opened on the 15th April. A large party from Hong-Kong, at the invitation of Mr. Ho Amei, visited and inspected the works. Mr. Ho Amei afterwards at a banquet, in reply to a toast, sketched the progress of the Company and expressed himself as hopeful of satisfactory results being obtained. The Superintending Engineer, Mr. Candler, also gave interesting details about the working of the mines.

PROVINCIAL PUBLIC WORKS IN THE N.-W. P.—The Department proposes to expend in the coming year the very handsome sum of Rs. 25,21,000 on "Provincial services." Of this 5½ lakhs go to "original works": nearly 13 lakhs to "repairs" and rather over 7 lakhs to "establishment, tool and plant." Of the "original works" again nearly 4 lakhs go to "civil buildings" and 1½ lakh to "communications." Similarly out of the 13 lakhs for repairs "civil buildings" take 3 lakhs and "communications" nearly 10 lakhs.

ARCHITECTURAL COMPETITION.—The design selected by the building committee of the Victoria Jubilee Hospital at Amritsar is that sent in under the motto of "*Æsculapius*" by Mr. W. N. Pogson, F.S.A., architect of Madras. Designs were invited by public competition, and the cost of the structure was not to exceed Rs. 75,000. The principal feature of the selected design is the adoption of circular wards, now so generally adopted in large and important hospitals. The style of architecture is Roman, so as to harmonize with the surrounding buildings.

THE MYSORE GOLD MINES.—In April two thousand one hundred and ninety-one odd tons of ore was crushed in the Mysore Gold Mines, which yielded one thousand four hundred and sixty-four ounces and fourteen grains of gold. The total stone crushed in the month was the highest, but the average yielded gold the lowest in the experience of the Company. Three hundred tons of

concentrated tailings yielded seventy-seven ounces of gold. The Nundydroog crushed three hundred tons for four hundred and ninety-eight ounces of gold.

NORTH BORNEO AND THE BRITISH PROTECTORATE.—We are glad to see the extension of the protective arm of the British Rule to this part of the Island, which has long been standing in need of some such active support. With the coming of this event, after the recent revolt which seriously menaced the British Settlement, we can see a glorious future for this country. Its mineral and forest wealth and virgin soil will soon feel the influence of Britannia's magic wand distributing and developing the germs of progress and civilization.

A SANITARIUM FOR ANGLO-INDIANS.—Penang proposes to follow the example of Hong-Kong and construct a tramway to the top of Penang hill. The hill is at present a health resort for a few of the residents, but as it takes now about two hours to reach the top from the jetty, the benefit can be enjoyed by but a few residents. A line of tramway has already been laid on the level in Penang, and it is proposed to continue this line to the top of the hill. The proposer of the scheme, however, wants a guarantee of three per cent. from the Government.

THE FINANCES.—From revised estimates shewing the actual outturn of the year 1887-88, it appears that the following are the net results, assuming that no change takes place in the English figures, namely, Rs. 3,07,000 better than the revised estimate if the special defence works are excluded, or Rs. 3,97,000 including them. In short, the deficit in the accounts may now be stated as follows: excluding special defence works by the revised estimates Rs. 24,48,000, as now estimated Rs. 21,41,000; including the defence works Rs. 30,17,000 and Rs. 26,20,000 respectively.

"BELLARY DIAMONDS."—A limited liability company is being formed for diamond digging in Madras, with a capital of £190,000. The company proposes to acquire 250 acres or thereabouts of freehold land, with the perpetual mining rights, situated in the district of Anantapore, in Madras, and also the perpetual mining rights of 304 acres or thereabouts situated in the same district. The price to be paid for the property and rights is £160,000, payable as to £60,000 in cash, and £100,000 in shares of the company to be issued as fully paid. We hope to say something on this subject later on.

PROGRESS IN SUMATRA.—The railways opened and under construction in Deli are expected to further materially the development of its teeming resources. So high are the expectations entertained on the subject, that the extension of the railway to the neighbouring district of Langkat, where planting enterprise has made much headway, has been strongly advocated. The extension will benefit not only the planters, but also the mercantile community. It is anticipated that a line of policy like this will further trade, and free the Colony from too much dependence on Penang and Singapore.

WANTED—A P. W. D. FOR SIAM.—A correspondent writes:—When will the Siamese, in their own interest, establish a Public Works Department? If they at present had such an office they might economize thousands every year, to say nothing of the tens of thousands which would have been saved in the past. If proof of this be required, we simply ask anyone to pay a visit to one or two of our

latest public buildings and express, if they can, a favorable opinion on the way in which these have been run up. We hear that all the tram gear has at last been shipped (in the beginning of March last) and may be expected to arrive in Bangkok ere this.

THE MYSORE P. W. D.—The prosecution of large works connected with the irrigation of Mysore, the preparation of other new projects, and the improvement of old existing works shew, says a contemporary, that a good lump of the D. P. W. Budget Grants is being devoted to the benefit of the ryot in a large measure, and to further remuneration to the revenues of the State. A very large tank, to cost about one lakh of rupees, is to be built in the Kolar District across the Pennar River; the extension of the irrigation channel from the well-known Hoskottay tank is another important work, while the irrigation channels connected with the great Maddur Anicut are about to be largely improved and extensively developed.

A DELIBERATE AND INTENTIONAL SNUB.—The mission of Mr. Barrington Brown appears to have been a deliberate and intentional snub, both to the Local Government and to the Indian authorities. It was tantamount to publicly stating that the Secretary of State would place more reliance upon the researches of his own men, than upon the statements furnished through the Viceroy in Council. In short, the Home authorities, evidently dissatisfied with the Streeter negotiation, calmly set aside the tentative arrangements of the Local Government, ignoring both their actions and opinions. The Secretary of State, probably fully informed by Unger and other interested parties, as to the political and official bearings of the case, will shortly be in possession of the commercial and scientific side of the question.

CHEAPNESS VERSUS EFFICIENCY.—After much wrangling the salary of the Municipal Engineer of Singapore has been increased to \$600 per mensem. The argument of the opposition was; Why should we pay a man \$600 a month when we can get another to do the same work for a little over half that sum? They seemed to forget that experience and local knowledge may make it worth while to give the higher salary. Moreover, \$600 a month is by no means too high a salary for a man who holds the position of Municipal Engineer to a community such as that of Singapore. The post is one of great responsibility, and therefore deserving of the highest salary that the community can reasonably afford. And who shall say that Singapore cannot afford to give its Chief Municipal Engineer \$600 a month?

RAILWAYS IN JAPAN.—A report by Mr. Trench, of the British Legation, Tokio, shews the rapid spread of railways in Japan during the past few years. The first railway, connecting Tokio with Yokohama, was opened in 1872. At present the Government has 245 miles open, 254 in course of construction, and 42 in contemplation, besides 56½ miles working in the island of Yezo; the Japan Railway Company, the interest on the paid-up capital of which is guaranteed by the Government, has 289 miles open and 240 in contemplation; while the sanction of the Government has been given to the construction by private companies of about 400 miles, and nine other lines are in contemplation also by private companies. Thus about 600 miles of railway are open, about 250 in course of construction, and about 700 in contemplation, besides a number

of private lines projected, the mileage of which is not given.

AN EXPENSIVE SURVEY.—The Assam Administration still cling to a scientific Cadastral Survey, although the cost rates are such as could only be justified by a very large increase of land revenue, or the most pressing administrative needs. A report recently issued by the Provincial department of Land Records and Agriculture shews that the lowest rate reached after three years' experience is Rs. 278 per square mile, which is nearly treble the ideal rate (Rs. 100 per square mile) to which Mr. Westland in his Budget statement averred that future surveys and settlements were to be reduced. The cost of the survey, so far as it has gone, is undoubtedly high, as was to be expected when the extraordinary difficulties to be contended with in Assam are borne in mind. The land is cut up by water-courses and covered with jungle, both natural and artificial, the people are unwilling to help, and the unhealthiness and remoteness of the country entail a large increase of expenditure on establishments.

IRRIGATION REVENUE REPORT, N.-W. P. AND OUDH.—A contemporary observes that financially the irrigation accounts of the North-West Provinces for the year 1886-87 are less satisfactory than they have been for many years past, while capital expenditure has risen from 420 lakhs to 770 lakhs. During the past ten years, net profits have fallen from Rs. 6 and 8 to Rs. 3, 5, and 6 per cent. The net income of the year was 25½ lakhs, which is exactly the amount earned at the beginning of the decade. To some extent this unfavorable return is due to the expenditure on the Betwa Canal, which cost 40 lakhs, and is, and probably will always be, except in seasons of drought, worked at a heavy loss. But the real cause was a decrease in the area irrigated by some 340,000 acres, chiefly under indigo, wheat, and barley. The contraction in the area under indigo is said to be due to heavy losses incurred in the previous season, while for the rest we have the usual stereotyped explanation that a favorable rainy season reduced the demand for canal water.

VOLUNTEER CYCLISTS.—Our contemporary the *Bombay Gazette* in its issue of 1st May, advocates the introduction of a "cycle" corps in Bombay, and in doing so descants on the various uses to which bicycles may be applied. It says: "Even for the conveyance of the sick bicycles have been utilized, and here the ordinary racing bicycle comes in very usefully. Two of these bicycles are placed back to back, their trail wheels being removed. Strong wooden bars connect the axles of the trail wheels, while others connect the handles of the two cycles. To this upper bar, a cot or hammock is suspended and this hammock is just large enough to contain a sick or wounded man, the bars being arranged accordingly. Four men run this along, and the value of it is that, although it takes up as many men as a stretcher, yet it can be moved as fast as the men can run, and is thus unlikely to hamper the movements of the troops." But it forgot to add that the originator of this arrangement was Mr. J. E. Whiting, the present Chief Engineer for Irrigation in Western India, who communicated it to this Journal in May last year. The Illustrated account of Mr. Whiting's invention as published by us was re-produced by the *Scientific American* and likewise copied by other journals far and wide.

Current News.

MR. BADEN-POWELL will, it is said, take up the editorship of the *Journal of Indian Art* before very long.

THE provisional sanction of the Punjab Government has been granted to the Ludhiana city drainage project.

DR. W. WALKER officiates as Surgeon-General and Sanitary Commissioner during the absence, on leave, of Sir Benjamin Simpson.

A LAHORE syndicate has applied to the Punjab Government for a concession for the construction of the Jullundur-Hushiarpur light line. They are still applying.

GENERAL ANNENKOFF reports that the Trans-Caspian Railway is finished as far as Samarkhand. The time for the opening ceremony is fixed for 27th May.

COLONEL JOHN STEWART, C. I. E., the Superintendent of the well known Harness and Saddle Factory at Cawnpore, was to retire from the service of Government on the 15th instant.

THE Resident's quarters at Katmandu being in a state of disrepair Rai Hem Chunder Chatterji, Supervisor, attached to the Chota-Nagpur Division, has been told off to repair it.

MR. RIBBENTROP, the Inspector-General of Forests, takes furlough within a couple of months or so, and Lieutenant-Colonel Bailey, who has before acted as Inspector-General, will probably do so again on this occasion.

THE Lieutenant-Governor of the Punjab is pleased to sanction the formation of a separate division on the Patiala-Bhatinda Railway, to be called the Patiala-Bhatinda Railway Stores Division, with head-quarters at Patiala.

SCARCITY of water has compelled the Maharaja of Jodhpur and his brothers to flee to various parts of the territory and remove the horses. All employes have been granted leave for three months. The Europeans have left, some for Australia, others for England.

MR. PARVATI NATH DUTT, who obtained the Gilchrist Scholarship in 1879, and who has since been studying at the Edinburgh and London Universities and the School of Mines, has been appointed by the Secretary of State an Assistant Superintendent in the Indian Geological Survey.

MR. A. R. BEECHER, Examiner, 3rd class, sub. *pro tem.*, is appointed to officiate as Deputy Accountant-General, Public Works Department, and Under-Secretary to the Government of India, Public Works Department, *vice* Mr. R. G. Macdonald, appointed Officiating Accountant-General.

THE Junagadh-Veraval Railway was opened last week. His Highness the Nawab Saheb and suite arrived by rail and a large crowd of people from the surrounding villages greeted his Highness with joy, and delivered addresses, offering congratulations and thanks, for providing them with railway communication.

THE report on the Ruby Mines which Mr. Barrington Browne has submitted to the Government of India is a short preliminary one only. His full account will be given in to the Secretary of State when he gets home. It is stated that Mr. Browne goes back with a robust belief in the mineral wealth of Upper Burma.

It is proposed to improve the fencing along the Mysore Railway line, to prevent cattle accidents, which are not of such rare occurrence as they ought to be. About Rs. 50,000 will be spent on the reconstruction of the bridges that came to grief during last year's rains. We are told that the Mysore Government will bear the cost of this.

THE Bombay Municipal Corporation considered the recommendation made by the Town Council to widen Church Gate Street as suggested by the Municipal Commissioner and sanctioned the proposal that the width of the street which was now forty feet should be increased to 75 feet. The total cost of the improvement would amount to Rs. 1,50,000.

A MANUAL for Mofussil Municipalities and Sanitary Engineers in India—a work extending over 400 pages of closely printed matter—is now in the press. It is from the pen of Mr. J. A. Jones, M. Inst. C.E. It will be profusely illustrated with photographic plans and woodcuts. The Manual is being published under authority of Government at the *Fort St. George Gazette Press*.

THE direct course of the Moradabad cyclone seems to have carefully avoided the meteorological stations, and thus no record can be given of its force. The number of deaths now recorded is 221. About 1,700 head of cattle were killed; and taking in the injury done to the mango crop, and to buildings and property generally, the disaster is as bad a one as has befallen any district in the Provinces for some years past.

MR. R. G. MACDONALD, Deputy Accountant-General, Public Works Department, and Officiating Under-Secretary to the Government of India, Public Works Department, is appointed to officiate as Accountant-General, Public Works Department, and Deputy Secretary to the Government of India in the Public Works Department, during the absence of Colonel A. J. Filgate, R.E., on furlough, or until further orders.

THE Bolan Railway has been closed since the 5th instant at the initiative of the Director-General of Railways from motives of economy. The saving will be over ten thousand rupees per month. The damage to the line by floods will be no worse than if it were regularly maintained, and the cost of repair, when required, no greater. The New Abt Railway works are about half completed. The closing of the line will facilitate the construction of the latter.

MR. GRIESBACH, of the Geological Survey, who went some months ago to Kabul to prospect for coal, gold, and precious stones, on behalf of the Amir, has been treated most kindly, not only by His Highness, but by all the Afghans with whom he has come in contact. Mr. Griesbach has travelled much about the country, and has been everywhere received most hospitably by all classes. Hostility to Englishmen appears to be a thing of the past in Afghanistan.

SOMEBODY says:—The members of the Madras Port Trust, as a rule (always excepting Major Baddeley) adopt too much of the "sit on him" style in dealing with Mr. Thorowgood, and appear to revel in the fact that he is their "servant," and treat him, in the correspondence, as if he were literally a "servant" of the grade of an Overlooker or Foreman, instead of being, as he is, a highly trained professional man. No officer with a grain of self-respect could tolerate such conduct.

THE construction of light railways is so constantly being urged as an economical means of connecting thinly populated districts with the main lines, that even a trade catalogue which throws light on the methods and cost of work of this kind has a public interest. Messrs. Fowler of Leeds are in treaty for the construction of a line from Nandgaum to Aurungabad, and in the highly probable event of the project being carried out an "object lesson" of great interest in cheap railway construction will be afforded.

THE *Darjeeling News* is rather proud of the local railway, and is wroth that Mr. Franklin Prestage, its originator, constructor, and successful managing director, has not been knighted ere this. There is no doubt that this little line is an engineering wonder, and has earned for Mr. Prestage the attention and respect of the leading Engineers of the world. Mr. Prestage, who also constructed the Eastern Bengal Line and so did a deal for Bengal and its commerce, well deserves any honor Government may confer on him.

ACCORDING to the *Times'* correspondent in the City of Palaces the native part of the town is almost as dangerous to health as any *terai*. Referring to Sir Donald Wallace's painful experience, he adds:—"It is hoped that Lord Dufferin's personal experience, fortified by the valuable lecture lately delivered in England by Mr. Justice Cunningham, will morally compel the Government to adopt at once drastic measures for an improved sanitation. The continued neglect of this vitally important question would be nothing less than a grave public scandal."

THERE are now at least three offers before the Secretary of State for the construction of a railway between Kalka and Umballa. Of the two rival offers which contemplate carrying the line downwards from Umballa by Kurnal to Delhi, the promoters of which ask for no Government help, the public know already. The less-known project put forward by Messrs. Mackinnon, Mackenzie and Co. for a line to Umballa only, stipulates, among other and minor conditions, for a bonus for one year about equal to the sum required to pay interest on the capital employed whilst the line is under construction.

WE learn that Mr. T. Inman, Executive Engineer, Bangalore Division, will proceed on three months' leave from 1st June next. It is in contemplation, we believe, to amalgamate the Bangalore and Palace Division, D. P. W., placing the same in charge of Mr. R. C. Scaldwell, Executive Engineer, Palace Division. On return of Mr. Inman from leave, it is likely he will take charge of the special Bridge Division, with head-quarters at Koppa for the purpose of pushing forward the completion of some large girder and masonry bridges on some of the main roads through the planting districts.

THE *Madras Standard* learns that from the commencement of the current official year Messrs. J. Dighton and Hormuzjee Naurojee, Assistant Engineers,—who until the 31st March last were in charge of the Madras Black Town Drainage Scheme,—have been transferred to the Maintenance of Way and Works branch, i.e., the construction of roads, &c., connected with the city. In giving publicity to this arrangement, it adds: Mr. Dighton was a fellow-student with the Editor of *INDIAN ENGINEERING* in the best days of the Madras C. E. College, and was one of the most distinguished pupils in Mathematics and Civil Engineering.

MR. MARTIN, formerly Architect to Government, is up at Darjeeling presiding at a Committee of Engineers, now sitting to examine and report on landslips going on in the Happy Valley Tea Estate, just below the new Secretariat, and to devise, if possible, some means of arresting their further progress. The Committee have a difficult job before them, as these slips have been going on for many years unnoticed and unchecked, and have reached such magnitude that it seems doubtful if human skill can now control them in any way. However, all who are acquainted with Mr. Martin know that the task could not be in better hands.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

USEFUL MEMORANDA.

SIR,—The following simple rules may be found useful to your readers:—

* 1. Diameter of wheel in inches \times No. of revolutions in a minute $\times .003$ = miles per hour.

2. On a 5' 6" gauge the versed sine of a chord of 66 feet gives the super elevation of the outer rail in curves, for a speed of 40 miles an hour (see Molesworth, page 213).

May 10, 1888.

M. INST. C.E.

3. A 72-inch driving wheel doing 200 revolutions a minute gives a speed of 43 miles an hour.
 $72 \times 200 \times .003 = 43.2$.

DYNAMITE.

SIR,—Can any of your readers or Mr. Harris, M. E., tell us why it takes 6 and 7 months to procure Dynamite and Detonators.

Since July last, there has been a great deal of trouble to get them at all. It takes six months to get a permission to be allowed to keep them on the collieries.

We have now had to fall back on *country made powder*, which is far more dangerous to workmen than what Dynamite is.

Why do not Nobel's Agents keep a small Depot, somewhere in these colliery districts—say at Assensole—where colliery Managers can send direct for what they want without troubling Railway bigots and timid magistrates.

Also can you give us any information about the new Explosives Act, which we are told, was passed some time last year.

DYNAMITER.

Bengul Collieries.

INFORMATION WANTED.

SIR,—Please insert the following queries in your valuable Journal:—

1. In the last edition of Molesworth (the 21st) on page 109 there is a formula for abutments for arch bridges. How should the figures $\frac{3}{5} R^2$ be taken, does it mean $\sqrt{R^2}$,

corresponding to the placing of the figures as in the $\frac{2}{3}$ powers, or

this, $\sqrt[3]{R^2}$.

2. Which is the best work on Civil Engineering for a practical man. I do not want one filled with complex and lengthy calculations like Rankine. It will have to be one that can be quoted as an authority when sending up papers, etc., to Superintending Engineers. I often serve on District and Municipal Boards and require something of this kind.

H. F. G.

[Ans. 1. Consult an Algebra or any one acquainted with the subject. The expression reads: three-fifths of the square root of the radius cubed.

Ans. 2. The Roorkee "Treatise" or Standard Specifications of the Province.]

RE-ORGANIZATION OF THE D. P. W.

SIR,—Your leader in your issue of the 14th April on the above subject deserves serious consideration. With your permission I shall offer a few remarks on the system adopted in Madras which is causing great dissatisfaction among the subordinates. A number of young men annually pass the Engineer's test at Madras and naturally expect to be appointed as Engineers; instead, only one is so appointed while the others are appointed as subordinates, thus burdening the Department annually with a number of discontented and disappointed young men. Those young B C Es are generally appointed Supervisors or Sub-engineers—thus barring the door to promotion of old and deserving subordinates, who seeing no prospects of advancement become disheartened and discontented.

Now I ask (1) Is it fair on the part of Government to encourage the young men to spend their time and money in edu-

cating themselves for Engineers to disappoint them by giving them subordinate appointments? (2) Is it fair to old and deserving subordinates who have spent the best part of their lives in the service of Government, to close the door to their further advancement? and (3) Is it to the interest of Government to appoint a lot of young discontented men to the higher appointments of the subordinate grades thereby making old and well experienced subordinates discontented also? If the same treatment was meted out to the Engineer officers of the Department would there not be a cry from one end of India to the other! Petitions and memorials would be sent in shoals to Parliament crying out against the injustice of the Indian Government. Imagine five men passing the test at Cooper's Hill College: one appointed Engineer while the others are appointed subordinates! Imagine also, Cooper's Hill Engineers after being a dozen years in the Department being superseded by fresh officers of the Royal Engineers.

REFINED CRUELTY.

"SOME ANOMALIES" EXPLAINED.

SIR,—I have read the letter signed Dog-Spike on "Some Anomalies" the gist of which apparently is that officers of the Traffic, Accounts and Engineering branch of the same service should get the same pay, whereas he quite forgets that it is just possible that Government considers a Traffic and an Accounts Officer to be worth more than an Engineer. The ultimate object of a railway, is that it should pay, therefore is quite right that those who are mostly responsible for its working so as to pay, should be picked men of great business capacity and high intellectual acquirements, and therefore more highly paid than their *compères*. This argument I have put forward for what it is worth—the real reason I think is that it is purely accidental and the outcome of the incremental scheme which is now held to be a sort of compound interest benefit fund to those in it.

Certainly when Government first began to work the lines it had constructed, volunteers for both Traffic and Loco. were called for, and for those who got in early, it has been an exceedingly good business, a few years landing them in good posts, so that the Engineers who stuck to their profession now find themselves quite out-paced.

Then again for want of men for open line works, Government had to promote deserving men from the lower ranks, and rightly so. I dare say half the officials of the State lines, including those brought in from Guaranteed lines, have worked up from the lower grades. Perhaps if the Engineers had been told, or could have foreseen how much better off they would have been had they joined the Revenue, they would have done so, but for those who care for their profession and take a pride in it, and who don't want to be maid of all work, I would say, keep to construction if you can. I believe, really, Government recognizing that the Engineer who has received as expensive, and as good an education as any other member of its allied services, would at once remove the anomaly if they could, and certainly the Cooper's Hill Engineers, to whom the Government are distinctly "ma bap," may trust their anxious but impecunious parent to help them out of their present difficulty. Let all Engineer Officers, Royal and Civil, be educated at Woolwich. Abolish Cooper's Hill and offer appointments in the Traffic and Loco. to be competed for as P. W. D. appointments were in the old Stanley Engineer days. Do away with that *bête noir* the incremental scale and Dog-Spike (if he is young and tenacious as his *nom de plume* portends) may yet rank with a District Traffic Superintendent.

NE SUTOR ULTRA CREPIDAM.

BROAD OR METRE GAUGE?

SIR,—Your article on the above subject fully bears out what I thought at the time I went into this question as you are aware.

I never was a thick and thin advocate of the broad gauge, the metre suits admirably, in fact is best in some districts, for instance the South Indian, but the Rajpootana was on the face of it a through route. One had only to look at a map of India to see that, and it is curious to look back on the question, how universally this view was held in Bombay, and how Simla would not see it. The result shews, as Major Conway Gordon says, which opinion, "the official or that of the mercantile community," was correct. Major Conway Gordon is most correct in his first para. I said so some years ago, theoretically the gauge of a railway might vary from the source of the traffic to the port or trade centre where the traffic collected, as in a system of drainage the drain pipe is not only cheaper but better at the beginning of the system and the small ovoid than the large and so on. There is no theoretically perfect gauge, it is a question of traffic. India would do very well if all its main routes were broad gauge and the blocks of country intervening were filled with a network of metre gauge, provided the said network was all connected and not in isolated lines and also connected with the network in another block by crossing the broad gauge lines. This would not always be best but might be taken as a fairly good arrangement for the whole country subject to important exceptions.

A difficulty is always to know what are through main routes. On this one can only say we should invite all the best opinions available, and not let the question be settled by one Secretary at Simla. In the comparison of the working power of broad or metre gauge lines one of the points which has not been thought

of much is that the broad gauge has not yet been worked up to its full capacity in any part of India, while I think the metre has. The metre was put on its mettle and having new lines and stock, the Engineers in England sent out heavier and heavier engines and larger and larger wagons, till they have reached a point which they can hardly pass. Meantime the B. G. lines had to use their old stock and have to still, besides they don't in most cases want more, but they can have more and a great deal more when they want it. Our goods engines are less powerful than those used on many lines in England. We have not put the load on our axles which we could, nowhere have I seen as large a wagon as it would be feasible and profitable to put on to B. G. if the traffic wanted it. And then as to passenger trains, we have not nearly reached the speed we can run with perfect safety. We have only just introduced bogie carriages and are only *thinking* of giving the accommodation and comfort which the gauge admits of and which I fear the metre gauge cannot reach. The broad gauge lines are in no case developed up to the point they admit of, and I should say that 10 years hence to contrast between broad and metre will be greater, and so great that people will wonder how we could ever have thought of the latter for a main route in this country of great distances. In speaking of engine and train capacity the heavy inclines like the Bore and Thul Ghats, G. I. P. Railway are exceptions; to increase their capacity further they must have more lines of rails, two lines are now pretty fully occupied.

It is now, of course, to be much regretted that the English 4-8½ gauge was not taken for India, not only would it have lessened the call for the metre gauge, but in time of famine and pressure whole ship loads of engines, carriages and wagons could have been sent from England at a week's notice.

M. I. C. E.

"INFORMATION SOUGHT"—SUPPLIED.

SIR,—With reference to the information sought by Mr. G. Dubern, in your issue of 5th May, it might be said, that there is no recognized rule for calculating boiler power—those now in use, being only approximate ones.

Makers of stationary engines estimate the boiler power by the length, the marine engineers estimate by the grate surface; whilst with many, the practice is to estimate the entire heating surface, and give an allowance for a horse power. But however correct any one of these rules may be for one description of boiler it will give a false result for a boiler of a different class. For instance, while one maker uses a '8, as a divisor for his grate surface, and calls the result his horse power, another makes '75; and a third one '5.

Under these conditions, a boiler of, say, 100 square feet grate surface, is capable of being classified as 125, 133 and 200 horse power. Where so much discrepancy exists in the very application of the rules, it is to be allowed that, the fact of the addition or subtraction of a few square feet of grate surface occupied by the dead plates, would not set the main question at rest.

It might repay Mr. Dubern, to investigate the various rules, or rather methods, for calculating the nominal horse power of a boiler.

Estimating the entire heating surface, and allowing for a cylindrical boiler 14 square feet of heating surface, and one square foot of grate surface; for a flue boiler 15 square feet of heating surface and three-fourths of a square foot of grate surface; and for a tubular boiler 16 square feet of heating surface, and half of a square foot of grate surface; Mr. Dubern might be enabled, to deduce the information he seeks, that is, whether the dead plates are to be taken into account, in the case he is dealing with, or not. For example, a tubular boiler of 48" diameter, 11' length, with 46—3" tubes, has a total of 501·8 square feet of heating surface, which being divided by 16, the number of square feet of heating surface to a horse power, gives 31 horse power. Half a square foot, being the proportion of grate surface; the grate surface for this boiler should therefore be 15½ square feet. It being borne in mind that by the term, grate surface, is meant, the *aggregate square feet of grate surface*, upon which coal is capable of being spread for combustion, regardless of any other condition.

The other methods are as follows:—

$$\text{For plain cylindrical boiler H. P.} = \frac{\text{Length} \times \text{Diameter}}{6}$$

$$\text{Single flue boiler H. P.} = \frac{(D + D') \times L}{7}$$

$$\text{Double flue boiler H. P.} = \frac{(D + D' + D'') \times L}{8}$$

If H = heating surface of a boiler, in square yards, and G = grate surface in square feet—

$$\text{H. P.} = \sqrt{(H \times G)} \text{ for plain boiler; and for tubular H. P.} = 1.8 \sqrt{(H \times G)}.$$

For marine boilers working up to nearly 5 times the nominal—

$$\text{H. P.} = .7 \sqrt{(H \times G)}.$$

Trusting the foregoing might be found useful.

C. L. PHILLIPS, M.E.

KUMARPORE; }
8th May '88. }

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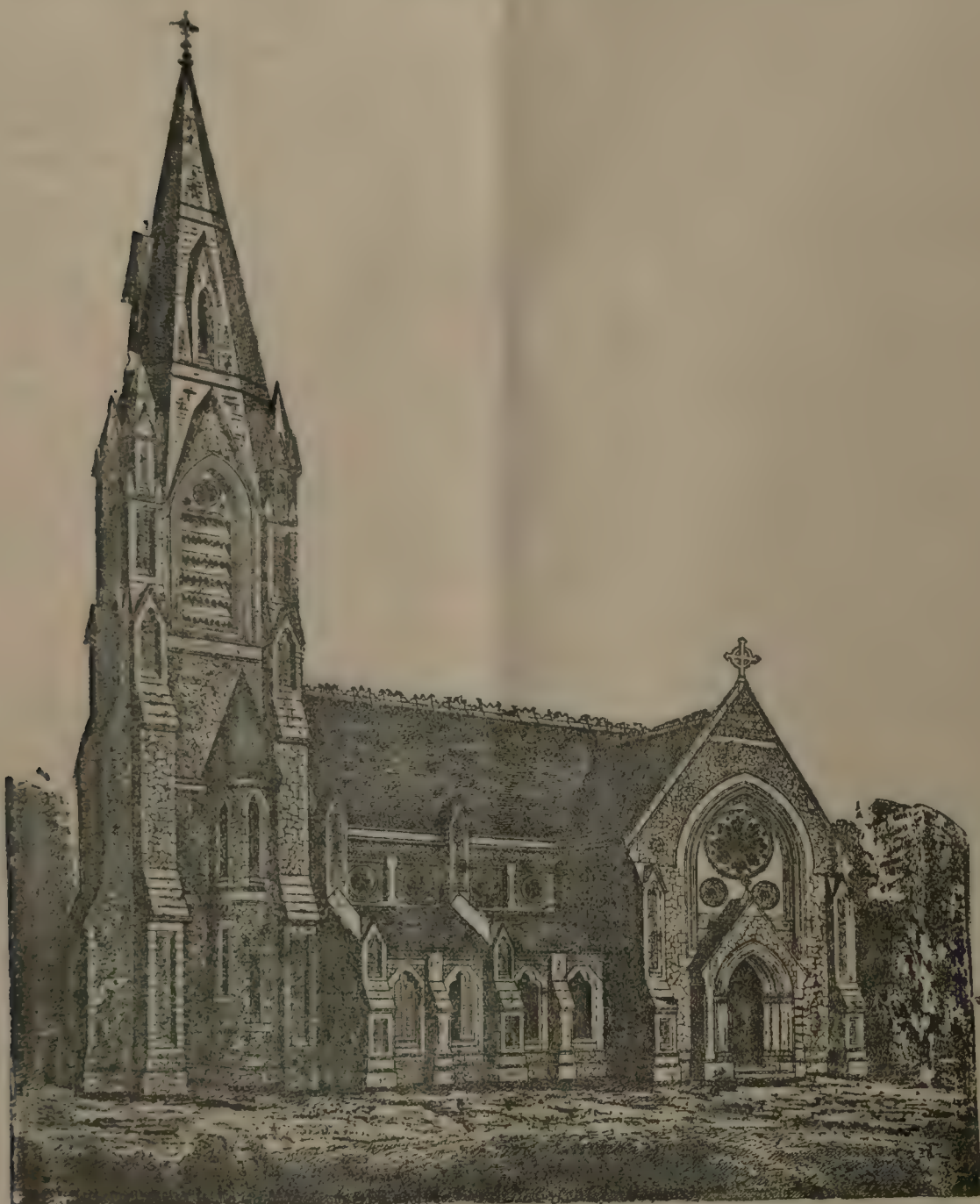
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General Articles.



CHURCH FOR THE LUTHERAN MISSION, COIMBATORE.

THIS building has been designed to meet the requirements of a native congregation. The style adopted is a modification of 13th century English Gothic. The accommodation provides for 450 worshippers, and its cost is estimated at Rs. 14,500. It is proposed to erect it with local stone in uncoursed rubble work similar to the Kentish Rag work of England, with dressed stone for quions, &c. The design is by W. N. Pogson, F.S.A., Architect of Madras, under whose superintendence the work will be carried out.

NEXT August will see the opening of the Centennial Exhibition at Melbourne, the cost of which is officially estimated at £ 217,000. This estimate, however, is likely to be exceeded, as not only several of the colonies, but Germany and France have applied for an increase of space.

THE Glasgow International Exhibition was opened on the 8th instant by His Royal Highness the Prince of Wales. Three large Courts have been assigned for the Indian exhibits in the Glasgow International Exhibition. The Indian exhibits are expected to number about 10,000, and there can be little doubt that they will form one of the most attractive features of the Exhibition.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK
XXXII.

CEILING cloth of double dungary including teakwood framing.

Items per 100 s. ft. (1)	No. or Quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
<i>Labor.</i> —				
Carpenters No. ...	1½	Variable.	Do.	Do.
Tailors " ...	1½			
Coolies " ...	1			
Sundries				
<i>Materials.</i> —				
Teak battens 2" × ¾" r.ft.	III			
Double dungary cloth				
yds. ...	20			
Tape yds. ...	30			
Tacks lb. ...	½			
Thread " ...	½			
Sundries, Scaffolding, Petty Establishment				

Note.—White or color-washing, or painting of ceiling not included in the details given.

DRAINAGE OF BLACK TOWN, MADRAS.

PLAN

SHEWING THE POSITION OF THE
SEWERS, PUMPING STATION, OUTFALL CHANNEL &c

Scale 6 inches = 1 Mile.



M S L.
SECTION FROM SEA TO CANAL

ON THE CONSTRUCTION OF SEWERS IN MADRAS.

BY HORMUSJI NOWROJI, B.C.E.,
Assistant Engineer, Madras Drainage Works.

V.

Flushing.—Every alternate man-hole has an arrangement for flushing the sewer. This consists of a groove in the sides of the man-hole for the reception of a framed board. When the board is inserted into the groove, it temporarily draws back the sewage until it attains the height of the top of the board. When the board is suddenly drawn out there is a rush of water and the head, due to the accumulated sewage behind the board, produces an increased velocity in the sewer sufficient to produce a scouring action. The flushing board is placed a few inches from the up stream side of the man-hole. The space between the board and the wall serves as an overflow when a board has been inadvertently left in the groove.

At the head of sewer No. 1, a flushing reservoir is built with a capacity of 1,600 gallons and is fitted with an automatic syphon on Field's principle. The reservoir is fed by a water pipe, and when the water rises to the level of the inner pipe of the syphon, it is brought at once into action, and the whole contents of the reservoir is discharged in a few minutes. The tank can be filled and discharged, as often as desirable by regulating the feeding pipe.

Cost.—The cost of the sewers in the revised estimate as subjoined stands at Rs. 2,04,000; the actual cost has fully reached this amount. This gives an average of Rs. 7-8-0 per lineal foot of sewer. A 24" diameter sewer at a depth of 16 feet below ground level and 5 feet below water line represents this average.

Estimate of cost of Intercepting Sewers—Drainage of Black Town—Madras.

Description of Works.	Quantity.	Rate.		Per.	Total.	
		Rs.	A. P.		Rs.	A. P.
Intercepting Sewer No. 1 ALONG POPHAM'S BROADWAY AND IBRAHIMJEE SAHIB STREET, <i>Storm Overflow Well in Esplanade.</i>						
Excavation ...	50 c. yd.	0	4	0 c. yd.	12	8 0
Brickwork ...	450 c. ft.	0	4	6 c. ft.	126	9 0
Plastering ...	8 sqrs.	5	0	0 square.	40	0 0
Self-acting flushing chamber fitted with annular syphon ...	Sum	0	0	0 ...	500	0 0
					679	1 0
<i>Excavation.</i>						
Excavation including timbering and re-filling above 6 feet deep ...	21,440 c. yd.	0	3	0 c. yd.	4,020	0 0
Excavation including timbering and re-filling below 6 feet deep to 21 feet deep ...	14,090 ,,	0	9	0 ,,	7,925	10 0
					11,944	1 0 0
<i>Sewers.</i>						
12 inch stoneware pipes including laying ...	256 l.ft.	2	8	0 l.ft.	640	0 0
18 inch stoneware pipes including laying ...	2,018 ,,	4	4	0 ,,	8,576	0 0
24 inch brick-in-cement ...	3,721 ,,	4	8	0 ,,	16,744	8 0
30 inch brick-in-cement ...	1,426 ,,	6	0	0 ,,	8,556	0 0
					34,517	0 0
<i>Man-holes with Ventilators.</i> No. 50.						
Brickwork in soorkee mortar ...	13,000 c. ft	4	0	0 c. ft.	3,656	4 0
Plastering 2 coats cement ...	84 sqrs.	5	0	0 square.	420	0 0
Do. 1 coat do. ...	147 ,,	4	0	0 ,,	588	0 0
Iron covers for ventilators ...	50 No.	25	0	0 each.	1,250	0 0

Revised Estimate of cost, &c.—(Continued.)

Description of Works.	Quantity.	Rate.		Per.	Total.		
		Rs.	A. P.		Rs.	A. P.	
Granite stones for covering man-holes	400 c. ft.	2	8	0 c. ft.	1,000	0	0
					6,914	4	0
Flushing doors ..	6 No.	20	0	0 each.	120	0	0
Extra for strengthening sewer under main drain, diversion of main drain, &c., &c., at crossings ...	3 No.	200	0	0 each.	600	0	0
Pumping ... ..	.....	...	...	sum.	13,500	0	0
Repairing and metalling roadways with 6 inch metalling and 3 inch bottoming	2,500sqrs.	4	10	0 Square.	11,562	8	0
Sewer No. 1.							
Abstract.							
Overflow well ... ..	...	...	...	...	679	1	0
Excavation ... ..	...	...	...	...	11,945	10	0
12, 18, 24 and 30 inch sewers ... ..	...	...	...	...	34,517	0	0
Man-holes and ventilators ... ..	...	...	...	...	6,914	4	0
Flushing doors ..	...	...	...	...	0	0	0
Strengthening sewers under main drain ... ..	...	...	...	...	600	0	0
Pumping ... ..	...	...	...	...	13,500	0	0
Repairing and remetalling roadways ... ..	...	...	...	...	11,562	8	0
Total ... ..	.....	...	...	...	79,838	7	0
Intercepting Sewer No. 2.							
ALONG WALL TAX ROAD AND OLD JAIL STREET.							
Excavation.							
Excavation including timbering and refilling above 6 feet deep	732,750cyd	0	3	0 C. yd.	6,140	10	0
Excavation including timbering and refilling below 6 feet deep to 11 feet deep	13,000 "	0	9	0 "	7,312	8	0
					13,453	2	0
Sewer.							
12 inch pipe sewer including laying	1,080l.ft.	2	8	0 l. ft.	2,700	0	0
18 inch pipe sewer including laying	6,322 "	4	4	0 "	26,868	8	0
24 inch brick-in-cement	4,621 "	4	8	0 "	20,794	8	0
					50,363	0	0
Man-holes with Ventilators.							
Brickwork in soorkee mortar	17,200c.ft	0	4	6 c. ft.	4,837	8	0
Plastering 2 coats cement	120sqrs.	5	0	0 square.	600	0	0
Do. 1 coat "	200 "	4	0	0 "	800	0	0
Wooden covers for raised man-holes	45Nos.	15	0	0 each	675	0	0
Granite covering stones for man-hole	224 c.ft.	2	8	0 c. ft.	560	0	0
Iron covers for ventilators	32 No.	25	0	0 each	800	0	0
					8,272	8	0
Flushing doors	9 No.	20	0	0 each	180	0	0
Pumping ... ..	...	...	...	sum	18,000	0	0
Raising and metalling roadways	270 sqrs.	4	10	0 square	1,248	12	0
Compensation.							
Compensation for crossing private land and removing cocoanut trees on the line of sewer	sum	...	...	...	1,200	0	0
Compensation for crossing under private property in Trevelyan, Terupally and Venkatasa Maistry Streets ... ..	"	...	...	...	3,000	0	0
Total ... ..	...	...	...	...	4,200	0	0
Sewer No. 2.							
Abstract.							
Excavation ... ..	...	...	...	...	13,453	2	0
12, 18, 24 inch sewers ... ..	...	...	...	...	50,363	0	0
Man-holes with ventilators ... ..	...	...	...	...	8,272	8	2
Flushing doors ... ..	...	...	...	...	180	0	0

Revised Estimate of cost, &c.—(Continued.)

Description of Works.	Quantity.	Rate.		Per.	Total.	
		Rs.	A. P.		Rs.	A. P.
Pumping ...	...	...	...	...	48,000	0 0
Raising and re-metalling roadways ...	...	...	...	...	1,248	12 0
Compensation ...	...	...	...	...	4,200	0 0
Total ...					95,717	6 0
Intercepting Sewer No. 3.						
FROM HARBOUR SEWER ALONG IBRAHIM SAHIB STREET TO No. 1 SEWER						
<i>Excavation.</i>						
Excavation above 6 feet deep including timbering and refilling ...	6,840c yds	0 2 0	c. yds.	...	855	0 0
Do. below 6 ft. deep to 21 ft. deep ...	8,790 "	0 7 0	"	...	3,845	10 0
Removing boulders from excavation 15 ft. deep near Beach Road ...	972 No.	0 2 6	each	...	151	14 0
Demolishing old masonry in chunam ...	2,800c. yds.	0 0 4	c. ft.	...	58	5 4
					4,910	13 4
<i>Sewer.</i>						
24 inch brick in soorkee sewer ...	2,270 l. ft.	3 4 0	l. ft.	...	7,377	8 0
Granite steps at junction with No. 1 Sewer ...	34 c. ft.	1 6 0	C. ft.	...	46	12 0
					7,424	4 0
<i>Manholes with Ventilators. No. 15.</i>						
Brick-work in soorkee mortar ...	3,500 c. ft.	0 4 6	c. ft.	...	984	6 6
Plastering in cement 2 coats ...	22½ sqrs	4 0 0	suare	...	90	0 0
Plastering in cement 1 coat ...	31 "	2 0 0	"	...	62	0 0
Iron covers for ventilators ...	12 No.	25 0 0	each	...	300	0 0
Wooden covers for man-holes ...	2 "	15 0 0	"	...	30	0 0
Granite stones for covering man-holes ...	104 c. ft.	1 6 0	c. ft.	...	143	0 0
					1,609	6 0
Flushing doors ...	6 No	20 0 0	each	...	120	0 0
<i>Repairing Roadways.</i>						
Relaying old metalling with 6" broken bricks for bottoming ...	228 sqrs.	0 8 0	square	...	114	0 0
Diverting Beach Road during construction of Sewer ...	45 "	1 0 0	"	...	45	0 0
					159	0 0
Baling and Pumping ...	...	...	...	...	8,930	0 0
Sewer No. 3. Abstract.						
Excavation ...	...	...	...	...	4,910	13 4
Sewer 24 inch diameter ...	...	...	...	...	7,424	4 0
Man-holes with ventilators ...	...	...	...	...	1,609	6 0
Flushing doors ...	...	...	...	...	120	0 0
Repairing roadways ...	...	...	...	...	159	0 0
Baling and pumping ...	...	...	...	...	8,930	0 0
Total ...					23,153	7 4
Sewer No. 4, from No. 1 & 2 Sewers to Pump-Well.						
<i>Excavation.</i>						
Excavation above 6 feet deep including timbering and refilling ...	940 c. yds.	0 3 0	c. yd.	...	176	4 0
Do. below 6 ft. deep to 23 ft. deep ...	1,880 "	1 0 0	"	...	1,880	0 0
					2,056	4 0
<i>36 inch Sewer</i>						
36 inch brick-in-cement sewer ...	221 l. ft.	9 0 0	l. ft.	...	1,989	0 0
<i>Man-hole No. 1.</i>						
Brick-work in soorkee mortar ...	390 c. ft.	0 4 6	c. ft.	...	169	11 0

Revised Estimate of cost, &c.—(Continued.)

Discription of Works.	Quantity.	Rate.		Per.	Total.	
		Rs.	A. P.		Rs.	A. P.
Plastering in cement 2 coats ...	2½ sqrs.	5 0 0	square.	...	13	12 0
Do. do. 1 coat ...	5 "	4 0 0	"	...	20	0 0
Iron cover for man-hole ...	1 No.	30 0 0	each.	...	30	0 0
Pumping ...	...	...	...	sum	173	7 0
Electric-light ...	...	...	...	"	600	0 0
Sewer No. 4. Abstract.						
Excavation ...	...	...	...	...	2,056	4 0
36 inch sewer ...	...	...	...	...	1,989	0 0
Man-hole ...	...	...	...	...	173	7 0
Pumping ...	...	...	...	...	600	0 0
Electric-light ...	...	...	...	...	300	0 0
Total ...					5,118	11 0

HORMUSJI NOWROJI.

A FLEXIBLE WATER SPACE FOR LOCO. AND OTHER FIRE-BOXES.

THE accompanying sketch shews a flexible stay for fire boxes patented by Mr. Leach, Chief Boiler Foreman, Central Shops, Ajmere, Rajpootana-Malwa Railway.

Much trouble and expense has been caused on the Rajpootana-Malwa Railway through the water space stays of the fire boxes of the metre gauge engines breaking off. These stays, which are of the ordinary type used in Loco. fire-boxes, are, when first put in, $\frac{7}{8}$ " diameter, and it is found that after an average mileage of 50,000 miles the stays begin to break off, first along the four top rows. The fracture takes place at that end of the stay which goes into the copper plate and the stay is broken off close to the plate inside the water space.

These top rows having given way the stays below this line then give way.

The failure of these stays is evidently due to the work and strain that is put upon them through the expansion and contraction of the copper fire-box, or to put it more clearly, its rise and fall. When fire is put into the box the heat causes the copper box to expand and from its form it expands most freely in its height, but the outer shell of the fire-box not being heated so quickly the stays between the copper box and the outside shell have to act like hinges to allow the copper box to rise or expand and when the copper is cool the stays have again to resume their original position.

This constant work on the stays eventually destroys the strength and fibre of the metal and the stays break.

The form of stay illustrated in the accompanying drawing and patented by Mr. Leach entirely gets over this difficulty and it has proved itself a practical success from the fact that 20,000 such stays have been put into the engines of the Rajpootana-Malwa Railway during the past four years and not one of them has failed or given trouble during this period.

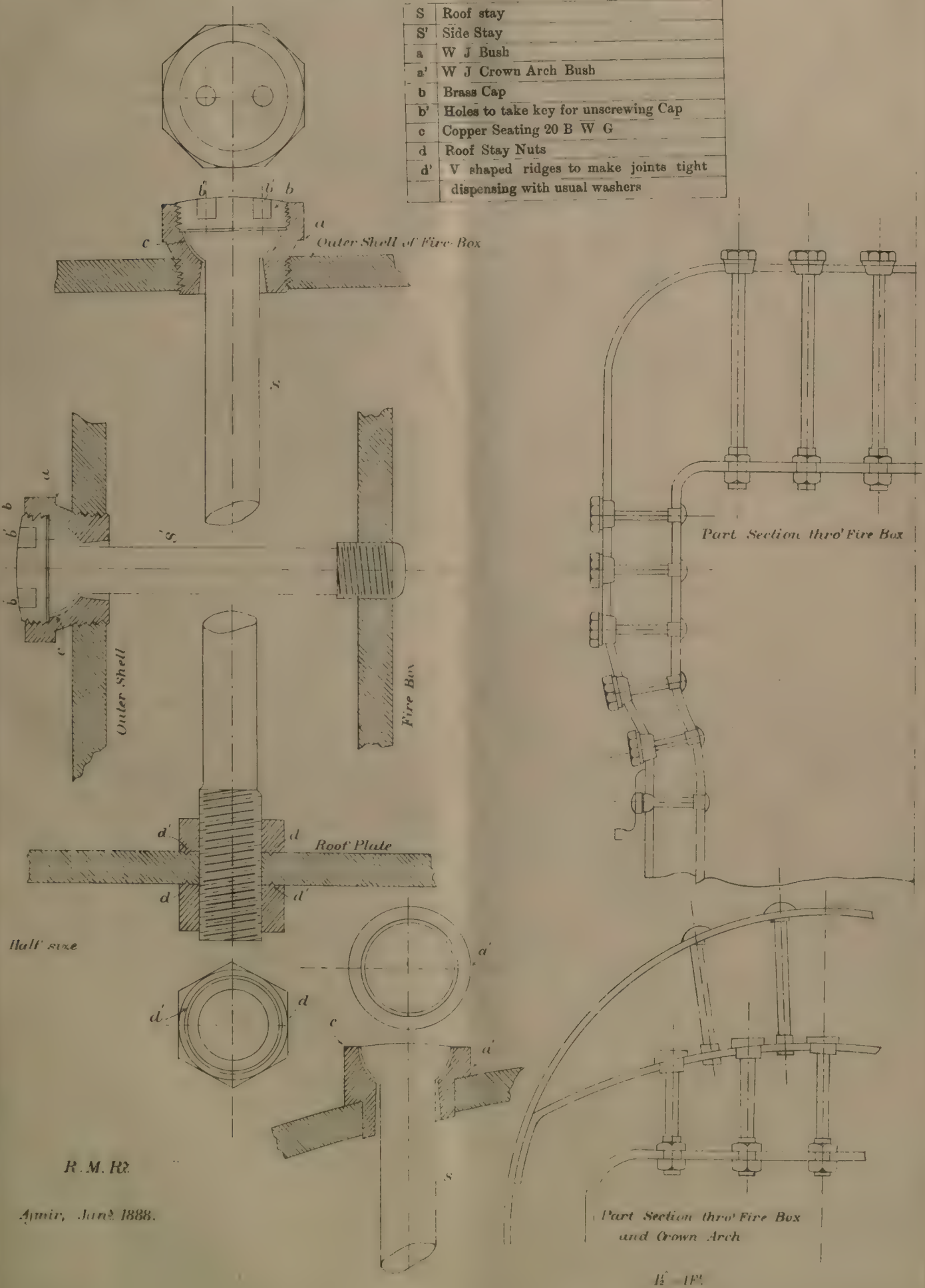
An engine which had been fitted with these stays and had worked from May 1885 to January 1888 and run a mileage of 85,018 miles was lately brought into Central Shops for examination. The stays were removed in various places in the fire-box for examination and were found as good as when they were put in.

In addition to the great success these stays have achieved as shewn above they possess an advantage over the old method in affording such an easy means of examining any of the stays in a fire-box as the removal of the cap b allows of the stays being examined at once.

Another advantage claimed is that the stays can be as well made of iron in this form as in copper as most of the old fashioned stays were. It will be noticed by a reference to the drawing that a thin copper washer is inserted between the neck of the stay and its seating

LEACH'S
Improved Flexible Fire Box Stay
For Locomotive Marine and Stationary Boilers.

S	Roof stay
S'	Side Stay
a	W J Bush
a'	W J Crown Arch Bush
b	Brass Cap
b'	Holes to take key for unscrewing Cap
c	Copper Seating 20 B W G
d	Roof Stay Nuts
d'	V shaped ridges to make joints tight dispensing with usual washers



R. M. R.

Amir, Jan 2 1888.

in the nut screwed into the outside shell of the fire-box.

It is obvious that in case the inside shell of the fire-box had to be removed for repairs that this new form of stay would be an advantage over the old form as being easier to remove and causing less damage to the fire-box.

Again should any of these stays require to be taken out at any time the bush or nut and copper washer do not need to be renewed, as they will come in again for any new stays, and the stay that is removed is available for working up into rivets or bolts.

The cost of these flexible stays, as compared with the ordinary stays, is as follows:—

	Rs.	A.	Ps.
Forging, turning and putting flexible iron stay in its place, including bush, cap, &c., each.	1	7	7
Making and putting ordinary copper stay in its place, each	1	8	8½

It is to be noted in comparing the cost of the stays that if the inside box has at any time to be removed through being burnt or damaged, that if flexible stays are already in, the stay only has to be removed at a cost of, say, 8 annas, whereas if the ordinary stay is in use the whole stay has to be renewed at its original cost; or, in fact, at a higher figure, as the stay will have to be of larger diameter, as in drilling it out of the outside shell the thread in the shell will get damaged and a larger size tap will have to be inserted to get up a full thread.

The illustration also shows Leach's Crown Arch, which form of stay for the roof of fire-boxes has long been used for the Rajpootana-Malwa Railway engines and with great success in place of the usual heavy bars, which in a metre gauge engine take up so much of the water spaces on the top of the box.

This crown arch has also been adopted by some of the other Railways in India and England. The illustration clearly explains the form of the stay.

FRANK GOODWIN.

NOTES FROM HOME.

(From our own Correspondent.)

At the close of a paper recently read before the Society of Arts by Mr. Jeans on "The Panama Canal and its Rivals" the author said if a canal was to be carried across the American Isthmus the work should be undertaken not by one nation or state, or company, but by a convention of Great Powers responsible for the expenditure which it would involve for the due and efficient completion of the undertaking, for its neutralization, regulation and maintenance. The three countries that were mainly interested were England, France and the United States.

Having received the Imperial sanction a company is to be formed for the construction and working of naptha conduits from Baku to Batoum, with powers to supply the public and eventually to construct branch conduits to Poti. The company is to be formed within four months, and the works are to be completed within a period of four years and four months.

In consequence of the amount of subscriptions received and promised being insufficient the Liverpool Cathedral Committee have decided to abandon for the present the building of the proposed Cathedral.

The Architects and Engineers' Registration Bill was recently brought up in the House of Commons for second reading, but, no doubt in consequence of the strong opposition to its provisions, was withdrawn. Petitions were sent in against it from the three Chartered Institutions—the Institution of Civil Engineers, the Royal Institution of British Architects and the Surveyors' Institution, also from the Association of Municipal Engineers and the Civil and Mechanical Engineers' Society. These representing the opposing voices of nearly eleven thousand members of the three professions.

The Institution of Mechanical Engineers give notice that their next meeting is to be held at the Institution of Civil Engineers on the 3rd and 4th of May when the following papers will be read:—(a) Third Report of the Research Committee on Friction: Experiments on the Friction

of a Collar Bearing. (b) "Description of the Emery Testing Machine" by H. R. Towne of Stamford, Connecticut, U. S. A. (c) Supplemental Paper on the use of Petroleum Refuse as Fuel in Locomotive Engines: by T. Urquhart, Locomotive Superintendent, Grazi and Tsartsin Railway, S. E. Russia.

In a paper on Compressed Oil Gas and its Application recently read at the Institution of Civil Engineers by Mr. Ayres it was stated that there are now 23,499 carriages illuminated on Pintsch's system, and 2,791 on Pope's system. Taking the double journey from London to Aberdeen the cost of compressed oil gas was 0.0404d. per lamp per hour, and for the ordinary oil system 0.385d. per hour. This shewed a greater cost for the ordinary oil system of 0.3446d. per lamp per hour or 8½ times more than oil gas.

The London, Brighton and South Coast Railway have now 15 trains lighted by electricity, two running between London and Brighton.

Although the electric light has been in use in the Victoria Station of this Railway since about the commencement of the year, it has been considered advisable to continue burning gas jets in the old lanterns, presumably in case of a collapse in the use of the illuminant.

The Corporation of Birmingham is about to institute an entirely new departure in the sale of gas by the use of "pay before delivery" meters. A number of prepayment meters constructed after the principle of the common automatic supply machines have been offered by inventors, and a trial of one devised by Mr. Brownhills is to be made in a court of small houses. One or more pennies are dropped into an opening and the regulating apparatus of the meter liberates a quantity of gas of corresponding value after which it stops awaiting the advent of fresh pence. It is stated that these meters can be manufactured for about 20s. each.

A triumph of modern chemistry is recorded whereby a waste and noxious bye-product of manufacturing industry is deprived of its objectionable character and transformed into a source of profit. In a paper read at a recent meeting of the London Section of the Society of Chemical Industry, Mr. Chance described the recovery of sulphur from alkali waste by the aid of lime-kiln gases, a process that crowns more than half a century of unsuccessful and costly experiment.

Delta metal is being extensively employed for the shafting and other portions of the fish torpedos in which it has replaced steel. It has also been used in constructing a number of new torpedo launches for the Russian Government, and propellers of the same material have been supplied to the Swedish ironclad *Tvea*, for which purpose it is superior to steel, as it does not suffer corrosion. The *Nyassa* steam canoe which has been built for the Universities African Mission Society and is intended for service on the lake of that name is entirely constructed of delta metal.

The *Statist* had recently an article on Copper, in which it examines whether it is possible to curtail the use of copper, and its conclusion is that substitutes can be used on a very large scale. For instance, the brass and copper used on a locomotive engine have hitherto been about 6½ tons, but by substituting iron and steel on various parts of the engine 4½ tons of copper out of the 6½ tons at present used can be replaced.

The new Railway between Barking and Pitsea on the London, Tilbury and South-end Railway will be opened next month. This line shortens the distance between London and Southend by about one-fifth, and moreover opens up a new district of South Essex hitherto quite untouched by Railways.

NOTES FROM BOMBAY.

(From our own Correspondent.)

Just at present no little excitement exists in Bombay, with reference to the proposed transfer of Sind to the Punjab Government. It would also appear that a strong feeling against the transfer, exists in Karachi itself, and that the sentiments in defence thereof expressed in a letter signed by a Karachi Merchant, which letter was published in the *Times of India* on the 12th April, by no means represent the views of the community on whose behalf he professes to speak.

The first grievance of Merchant seems to lie in the absence of a daily Postal system between Karachi and the presidency; but it is due to no fault of the Bombay Government that such a postal system does not exist.

Another grievance ventilated by him is the alleged disregard evinced by Bombay to proposals emanating from Karachi, that Sind might be connected with the Presidency system of Railways.

A third grievance is that the assistance of the Bombay Government was not forthcoming when solicited, to a project embracing the construction of a surface-line of railway from Hyderabad to Umerkot.

The *Times of India* adverting to the above letter, points out how strenuously the Bombay Government really has, for a long time past, endeavoured to bring about the re-habilitation of the postal system. In this matter, as also with regard to the railway projects alluded to by Merchant, the Supreme Government alone could exercise rights of decision; but the Bombay Government has done everything that lay in its power to promote the very objects Merchant accuses it of having discountenanced.

It cannot but strike one as very curious, that Bombay in which 48 Fire Insurance Companies flourish, has so poor a Fire Brigade service. Many a Provincial town in England is better provided for, notwithstanding the immense value of our public buildings, and the extent of our populous city. All that Bombay can boast of to protect life and property from fire is:—

1	Steam-Engine at	Hornby Row Station.
1	" " "	Pydownie Station.
1	" " "	Upper Duncan Road Station.
1	" " "	Byculla Office Station.
1	" " "	Mahim Station.
1	" " "	Parel Station.

How inadequate such protection is, may one day be realized in a terrible amount of destruction to property, to say nothing of loss to life, unless our deficient fire-system be soon improved.

The Bombay Harbour Defences are being vigorously prosecuted under the able supervision of Colonel Meriman. In a matter of this kind, it would be indiscreet to go into details. It is sufficient to record the fact that good and substantial progress is being made.

The question as to the regularity or otherwise of the conditions, under which leave was recently granted to Mr. Rienzi Walton, Executive Engineer, Bombay Municipality, has been finally disposed of by the Town Council, to whom it had been referred by the Corporation. The latter, in terms of a resolution passed on the 3rd February last, asked:—"That the Town Council be requested to inform the Corporation (1) whether the rules under which leave is granted to Municipal Officers, are the rules of the Uncovenanted Service of Government and (2) whether the conditions under which leave has recently been granted to the Executive Engineer of the Municipality, are the conditions which have never previously been adopted or recognized by the Town Council."

To the first query the Town Council replied that the rules under which leave is granted to Municipal Officers are not those of the Uncovenanted Service of Government; the Council having the right under Section 58 of the Municipal Act, to grant such leave as might seem proper to them. In reply to the second query the Council informed the Corporation that the conditions under which leave was granted to Mr. Walton are not the conditions which had ever been previously adopted or recognized under the Uncovenanted Service Rules of Government, these latter being made applicable in cases of allowances only under the authority of Section 59 of the Act, because such a case had never previously occurred. It is to be regretted that any dispute ever arose as to leave, rendered essential by the illness of a meritorious and hard working officer, which Mr. Walton undeniably is.

Mr. R. M. Sayani has been elected Chairman of the Corporation, and there is every reason to believe that he will prove well qualified for his office. He has been preceded by a long array of able men, among the foremost of whom stands his immediate predecessor, our popular citizen and Port Officer, Sir Henry Morland.

The weather here is extremely hot and enervating, the average temperature during the day being about 90° in the shade. The nights, too, are very hot, and discomfort is the order of the day. Not the least of these discomforts—indeed it may be called an intolerable nuisance—is the dusty state of the roads. I will not say that the Municipal Water-carts do not discharge their functions with customary regularity; but the roads give little evidence of their

activity and beneficent influence. The *Annales Industrielles* lately described a machine for the simultaneous sweeping and sprinkling of streets, which has been adopted by the Municipality of Valentia. Something of the same kind would be very acceptable here during the present hot weather.

XENOPHON.

NOTES FROM BURMA.

(From our own Correspondent.)

THE Local Government is still handicapped owing to the small grant available for provincial public works to undertake any large improvements in the communications by land and water. The principal works that have been undertaken are a bowstring girder bridge of 100 feet span over the Letwedet stream on the Naaf and Mayu road, in the Arracan Division, which was started in 1886 and just completed. The work of renewing the piles of the Cheduba bridge and lifting and straightening the floor beams is also finished. The screw pile bridge over the Tunyaung stream on the road from Thabyagon to Thabyakwin is also completed at a cost of Rs 15,930. In the Tharrawaddy Division it is contemplated to erect an iron lattice girder bridge of 80 feet span over the Minbuchaung, and materials for the abutments are now being collected.

The only road of any importance that is now being undertaken is that from Tongyi on the Sittang Railway to the Pegu river bank; an outlay of Rs. 24,340 has been expended on this work up to date. Many of the roads throughout the province, although bridged, are not metalled for want of funds.

A scheme for rendering the canal navigable between the Sittang and Salween, though commenced so far back as 1884, has since been modified. The original plan was to excavate a canal from Winpadaw on the Sittang to Kawkareik on the Dondami river, which flows into the Salween, and divided into the three following sections:—

Winpadaw to Kyaikto	...	...	14 miles.
Kyaikto to Bilin	...	...	18 "
Bilin to Kawkareik	...	...	8 "

The cost of completing the first section of 14 miles was estimated at Rs. 2,35,970, and although Rs. 1,16,700 was expended in starting the work, further progress was impeded for want of funds, and the work abandoned since 1885. The importance of carrying out this project is again before the Local Government, who have sanctioned 1 lakh towards the completion of the first section only, and cancelled the latter two sections for the present. The estimated cost of the three sections, according to the original plan, was Rs. 3,50,000. Should the first proposal be carried out, it would be the means of developing the extensive inland rice and teak centres, where the only means of convenient transport now available is by conveying grain in boats and floating timber during the monsoons.

The steady encroachment of the river on the embankment at Henzada has induced the Engineer to try a novel experiment; this is by floating tree spurs at an angle of 70 degrees across the bund; this experiment has been found to answer its purpose, and similar steps are now being taken to protect the Ngawun embankment in the Bassein district.

The breach caused by the bursting of the bund on the Bilin river, causing damage to the railway lines, has been repaired at a cost of Rs. 19,240.

Diputes appear to be rather the rule than the exception in the working of the mines in Burma, which, in a great measure, accounts for the failures that have attended the different mining companies in this Province, and undoubtedly detrimental to the interests of shareholders. In connection with the oil wells in Arracan, we have Mr. J. J. Senior, who is working the property of the defunct Boronga Oil Company engaged in a law suit with the Arracan Petroleum Company, and the shareholders of the Titawle Lead Mine in the Tenasserim Division, engaged in a law suit in England, with the original promoter, Mr. Law, of Maulmain. However, I have to record with pleasure the success attending our enterprising townsman, Mr. G. E. L. Dawson, who has succeeded in extracting several tons of lead ore from Maingay island, where he has obtained the right to prospect, and several samples have already been sent to Europe for analysis. Messrs. David and William Bell, the oil experts from America, did not succeed in discovering any valuable wells in Arracan.

Art Industries.—Since the Government have ceased connection with this Institution, the leading workmen, both in

silver work and wood-carving, have formed themselves into small companies. Specimens of their handicraft have already been introduced into the European markets, and a steady rising demand will induce the artists of this Province to improve in their workmanship, which was fast deteriorating, but for the timely support of Government. A great demand is now being made from England for wood-carving, where it is used for interior decorations.

The introduction of a new cement by Mr. A. C. Hoare, formerly of Ceylon, and now of this city, is likely to revolutionize the use of Portland cement if more widely known. The composition is at present a secret, and only known to the maker, who intends taking out a patent. From a series of experiments conducted, it was found that the adhesive strength of the new cement is much greater than Portland, and it acts alike in masonry, metal, and woodwork. The cement is applied hot and dries in a few minutes. It is believed the cost of preparing the cement is less than preparing Portland, and is used without the admixture of sand.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, May 5, 1888.

Lower Burma.

Mr. H. Luckstedt, Executive Engineer, 3rd grade, took over charge of the 1st Division of the Toungoo-Mandalay Extension, Burma State Railway, from Mr. J. M. Salmond, Executive Engineer, 3rd grade, on the afternoon of the 16th April 1888.

Mr. G. T. St. A. Nixon, Assistant Engineer, 1st grade, Railway Branch, is temporarily attached to the office of the Secretary to the Chief Commissioner, Public Works Department, Lower Burma, for employment on Railway Secretariat duties, with effect from the afternoon of the 30th April 1888.

Mr. W. R. Foy, Assistant Engineer, 1st grade, is transferred from the Amherst to the Tharrawaddy Division. This cancels Notification dated the 30th March 1888.

Madras, May 8, 1888.

The following promotions are made :—

Honorary Captain and Deputy Commissary W. C. S. West, Sub-Engineer, 1st grade, and Assistant Engineer, 2nd grade, supernumerary, to Assistant Engineer, 1st grade, permanent (supernumerary), with effect from 5th December 1887.

Honorary Lieutenant and Deputy Assistant Commissary A. Milne, Sub-Engineer, 1st grade, to Assistant Engineer, 1st grade, permanent (supernumerary), with effect from 5th December 1887.

Bombay, May 10, 1888.

Mr. Karpur Shrinivasrao, B.E., L.C.E., Apprentice Engineer, having completed a year's probation, is promoted to Assistant Engineer, 3rd grade, with effect from 4th March 1888.

His Excellency the Governor in Council is pleased to appoint Mr. Ganesh Ramchandra, Sub-Engineer, 2nd grade, to be an Honorary Assistant Engineer of the 2nd grade.

Mr. J. A. Coghlan, Executive Engineer, 1st grade, is allowed furlough for six months with the usual subsidiary leave.

Mr. R. R. Menneer is appointed to act as Executive Engineer, Eastern Nara, during the absence of Mr. J. A. Coghlan, on furlough, or until further orders.

Central Provinces, May 12, 1888.

Two months' privilege leave is granted to Rao Sahib D. S. Sathye, Assistant Engineer, Jabulpore Division, with effect from the date on which he may be permitted to avail himself of it.

India, May 12, 1888.

With reference to Public Works Department Notification, dated the 23rd November 1887, Mr. H. T. Geoghegan, Superintending Engineer, 1st class, State Railways, has been granted, by Her Majesty's Secretary of State, a further extension of leave for five months on medical certificate.

The services of Lieutenants C. H. Cowie, R.E., and E. W. Walton, R.E., Assistant Engineers, 1st and 2nd grades, respectively, State Railways, are, on return from the Military Works Department, transferred to the Establishment under the Government of Bengal.

Major F. V. Corbett, R.E., Executive Engineer, 1st grade, North-Western Provinces and Oudh, is appointed to officiate as Superintending Engineer, class III., temporary rank, with effect from the 16th April 1888.

Lieutenant Archibald Douglas Graham Shelley, R.E., is appointed to the Public Works Department as an Assistant Engineer, 2nd grade, and posted to State Railways.

With reference to the above Public Works Department Notification, Lieutenant A. D. G. Shelley, R.E., is attached to the Office of the Consulting Engineer for Railways, Madras.

Mr. J. S. Beresford, Executive Engineer, 1st grade, North-Western Provinces and Oudh, is appointed to officiate as a Superintending Engineer, during the absence, on leave, of Mr. A. J. Hughes, or until further orders.

Baluchistan.

Mr. W. H. Rushton, Assistant Engineer, 1st grade, is transferred from the 2nd to the 1st Division, Frontier Road.

Bengal, May 16, 1888.

Establishment—General.

Mr. W. H. Nightingale, Inspector of Local Works in the Bhagalpore Division, is allowed privilege leave for six weeks, under section 74, chapter V. of the Civil Leave Code, with effect from the 25th instant, or such subsequent date as he may avail himself of it.

Mr. W. H. King, Executive Engineer, is, on return from furlough, appointed to officiate as Inspector of Local Works in the Bhagalpore Division, during the absence, on privilege leave, of Mr. W. H. Nightingale, or until further orders.

Establishment—Railways.

With reference to Government of India, Public Works Department Notification, dated 9th May 1888, Lieutenant C. H. Cowie, R.E., Assistant Engineer, 1st grade, is posted to the Eastern Bengal State Railway.

With reference to Government of India, Public Works Department Notification, dated 9th May 1888, Lieutenant E. W. Walton, R.E., Assistant Engineer, 2nd grade, is posted to the Tirhoot State Railway.

Establishment—Irrigation.

Mr. G. C. Stawell, Assistant Engineer, is transferred from the Acquapada-Jajepore to the Brahmini-Bvtturni Division.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 30th April 1888.

203 of '87.—Walter Holland, the Younger, Civil Engineer, of the Vulcan Iron Works, Worcester, in the County of Worcester, England, and William Thomas Page, Civil Engineer, of the Vulcan Iron Works, Worcester aforesaid.—*For improvements in machinery or apparatus for working and interlocking points and signals on railways*

218 of '87.—Andrew Lyle, His Highness the Nizam's Guaranteed State Railway Company, Limited, Secunderabad, Chief Inspector of Maintenance.—*For carrying Railway signal or other wires called "Lyle's signal wire carriers."*

16 of '88.—William Webster, Junior, Electrician, of 50 Lee Park, Lee, in the County of Kent, England.—*For improvements in the treatment of sewage and other impure liquids and water for the purification thereof and for obtaining products therefrom and in apparatus for these purposes.*

19 of '88.—George Horatio Jones, of London, England, Physician.—*For improvements in bottle stoppers.*

65 of '88.—John Scott Wells, of Newcastle Terrace, the Park, Nottingham, England, Hosiery Manufacturer.—*For improvements in knitted undervests and in their manufacture.*

The 7th May 1888.

1 of '88.—William Thomas Seymour, of 14 Regent Street, Stockton-on-Tees, England, Tin Plate Worker.—*For improvements in lids or covers, and in fitting them to metallic or other receptacles.*

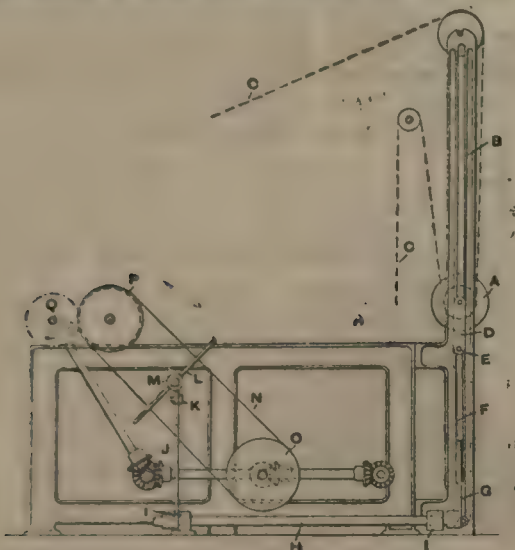
10 of '88.—Friedrich Georg Winkler, of Zschopau, in the Empire of Germany, Manufacturer.—*For improvements in sifting or bolting machinery.*

42 of '88.—The Westinghouse Brake Company, Limited, of Canal Road, Kings Cross, in the County of Middlesex, England.—*For improvements in fluid pressure automatic brake mechanism.*

RECENT BRITISH PATENTS.

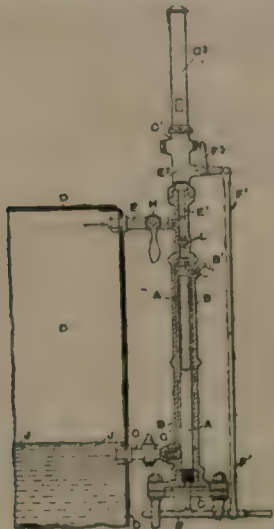
SIZING, DRYING, AND WARPING MACHINES.—*E. Brook, Huddersfield, and J. Vickerman, Mirfield, Yorkshire.*—In the ordinary machines for combining the three processes of sizing, drying, and warping, the increasing diameter of the coil of threads wound in the warping mill tends to increase the tension on the threads as they come from the letting off rollers in the drying machine. The object of this invention is to provide an automatic regulator of the tension. The accompanying figure illustrates an end elevation of one of the two modifications of the improved apparatus. The essential feature is the application of a loosely mounted rising and falling roller A, and the frame work B for guiding its motions. Its position is dependent on the tension of the threads C, which in their passage from the sizing machine to the warping mill are caused to pass under and support the roller in the manner shown in the figure. The spindle D is connected by the arms and cross bar E and rod F to a lever arm G which projects from a

rocking shaft H. Another arm J fixed to the rocking shaft is linked to the belt shipper L, which works on a guide rod M. The belt N



passes partly round a pair of slightly conical pulleys O P. The small end of one pulley is arranged opposite the large end of the other, so that as the belt is shifted from the large end of the driving pulley towards the large end of the driven pulley by the increased tension in the threads, the warping mill is caused to run somewhat slower. When one section has been wound on the warping mill and another section is commenced, the tension on the threads C is least, and the mill may not take the threads up as fast as they are let off from the drying machine. This defect is immediately rectified by the roller falling by the action of gravity. Afterwards the roller in its descent drags the belt shipper and belt towards the large end of the driving pulley, as described. In the second modification the object is attained simply by the use of a weighted roller which is suspended by the threads. This method is only applicable where there is very little variation of tension. The inventors make two claims, one for each modification.—No. 4591. March 28th, 1887.

REGULATING THE LEVEL OF WATER IN BOILERS.—*J. Murrie, Glasgow.*—Certain improvements are here introduced into the construction of the apparatus described in Patents No. 303 of 1885, and No. 2520 of 1886. The object of the apparatus is to indicate and regulate the temperature and pressure of the water, and is particularly applicable for regulating the level of water in boilers. One form of the indicator is shown in section in the accompanying diagram. The expansion chamber A and the heating chamber B are placed vertically, and the latter is connected near its lower end by a single tube and port G to the boiler D at the point of the lowest water level desired. The tube E connects the steam space in the boiler D with the tube E¹, which leads to the branch E² of the valve C¹; the whistle C²,



giving an audible indication when the water falls below the level of the tube G, is also connected with the tube E¹. The tube E¹ is also in communication with the top of the heater B, and the taps H L are fitted in the tubes E E¹ for the purposes of testing the working of the apparatus from time to time. The cock B¹ on the top of the heating chamber B allows the testing of the circulation of fluid within it. The action of this apparatus is as follows: On the water falling below the tube G, the steam enters and displaces the whole of the water in the upper part of B, and suddenly heats the fluid contained in the vessel A. The vapour thereby generated in the upper part of A presses down the liquid in the chamber of the diaphragm C, which being deflected outwards, depresses the lever F, and raises the rod and bell crank lever F¹ F². The valve C¹ is thus opened, and the steam enters from the boiler through the pipes E E¹ E², and sounds the whistle C². Four claims are made for this apparatus and for several modifications.—No. 1770. 4th February 1887.

PUBLIC WORKS DEPARTMENT, AKRA BRICK FACTORY DIVISION. NOTIFICATION. **SAND.**

The right to excavate Sand for the period of 12 months from 1st June 1888 to 31st May 1889, from the Chur called "Buddertollah Sand Chur" being Holdings No. 1311 and 1312, 24P. Collectorate, will be sold by public auction on Thursday, the 31st May 1888, at 3 P. M., in the Office of the Superintendent of Akra Brick Factory, where particulars as to terms and conditions of sale can be learnt.

S. C. GHOSE, *Rai Bahadoor,*
DATED AKRA, } SUPERINTENDENT,
The 15th May 1888. } Akra Brick Factory Division.

WANTED.

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The Mirzapur Stone and Trading Co., Cut-Stone Contractors and Quarrymen Mirzapur, can supply—

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Pillar Bases	Coping.

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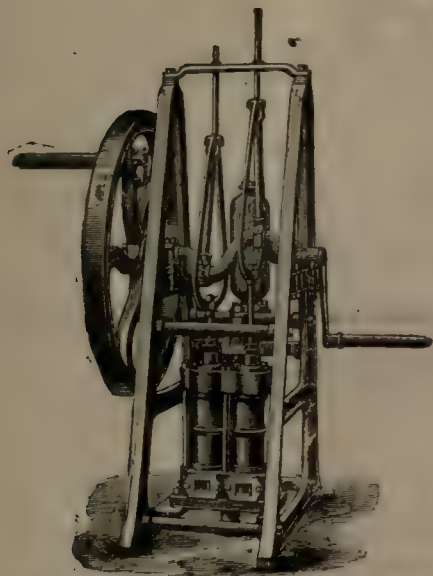
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A very large and miscellaneous stock of every possible requirement for Engineers.

(112)

In the matter of the Indian Companies Act, 1882.

AND

In the matter of the Deoghur Mining Company, Ltd.
FOR SALE.

THE mining and other rights of the above Company in Mouzahs Toolsitar, Loth Bedooa, Churkidangi, Bissenpore, and Mongua Reidea, in Talook Ropinee in the Sub-district of Deoghur, in the Sonthal Pergunnahs, comprising 6,057 biggahs, or thereabouts, under a lease, dated the 29th May 1883, for 149 years from 29th May 1883, and as to Mouzahs Toolsitar and Churkidangi under conveyances from the Mustagirs thereof respectively.

2—The Engines, Plant, Machinery, and Stores of the above Company, at Deoghur, including (among other things)

- 1—Tubular Engine Boiler with fittings complete.
- 1—Tangye's Vertical Boiler with fittings complete.
- 1—Winding Engine with fly wheel and drum.
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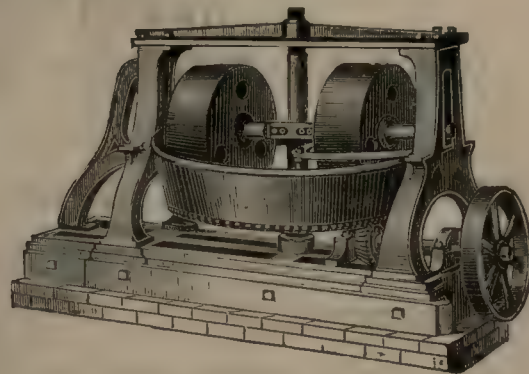
For full particulars apply to the undersigned, by whom offers will be received up to the 31st May 1888.

DIGNAM, ROBINSON & SPARKES,

*Attorneys for the Liquidator
of the abovenamed Company.*

4, STRAND, CALCUTTA ; }
24th April 1888. }

(118)



Steam Mortar Mills with
innumerable improvements.
Guaranteed of exceptional
construction and design.

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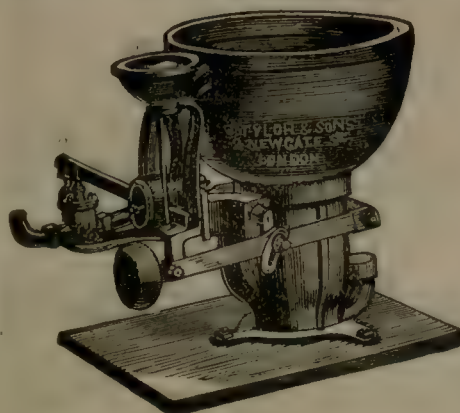
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(120)

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Mechanical Engineer,
PROPRIETOR.

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SITUATE AT

WADJRA KARUR (VILLAGE OF DIAMONDS)

NEAR BELLARY, MADRAS.

INCORPORATED UNDER THE LIMITED LIABILITY ACTS, 1862 to 1883.

CAPITAL, £190,000, IN 38,000 SHARES OF £5 EACH.

OF WHICH 18,000 SHARES ARE NOW OFFERED FOR SUBSCRIPTION.

(2,000 BEING RESERVED FOR INDIA, AT RS. 75, THIRTY RUPEES PER SHARE PAYABLE ON APPLICATION.)

Payable 10s. per Share on Application.

Payable £1 10s. per Share on Allotment.

Further Calls will be made as required. No Call to exceed £1 per Share, or be made at intervals of less than one month.

Shareholders desiring to pay up in full, on allotment, can do so. Interest at Six per cent. per annum will be allowed on such pre-payment.

DIRECTORS:

ROBERT E. NORTH, Esq. (Messrs. R. E. NORTH & Co.),
57-D, Hatton Garden, E.C. (Managing Director of the
Diamond-Cutting Company).

W. CARLTON WOOD, Esq., 41, Basinghall Street, E.C.

EDMOND POWER, Esq. (Messrs. REMINGTON & Co.),
Henrietta Street, Covent Garden, W.

BENJAMIN W. FORD, Esq., 38, Leadenhall Street, E.C.
*CHARLES H. STRUTT, Esq., 5, Harrington Gardens,
S.W.

*ROBERT GORDON ORR, Esq. (Messrs. P. ORR &
Sons), Madras, Resident Director. (Chairman of the
Commercial Land-Mortgage Bank of Madras, Limited.)

* Will join the Board after Allotment.

Commercial Agents in India.—MESSRS. P. ORR & SONS, Madras, Diamond Merchants, Jewellers, and Goldsmiths.

Resident Engineer in India.—MR. ROWLAND BATEMAN SMYTH (Late of the Geological Survey of India.)

Bankers.—MESSRS. HENRY S. KING & CO., 65, Cornhill,
E.C.

Brokers.—MESSRS. LANE BROTHERS, 22, Threadneedle
Street, E.C., and Stock Exchange.

Solicitors.—MESSRS. SLADE & MUNK, St. Clement's House, Clement's Lane, E.C.

Auditors.—MESSRS. JOHN F. LOVERING & CO., Chartered Accountants, 77, Gresham Street, E.C.

Secretary.—MR. A. W. BROWNING.

Offices.—Winchester House, Old Broad Street, E.C.

This Company has been formed to acquire 250 acres or thereabouts of Freehold Land with the Perpetual Mining Rights, situated at Wadjra Karur, in the district of Annantapur, in the Presidency of Madras; and also the Perpetual Mining Rights of 304 acres or thereabouts situated in the same district, making in all 554 acres.

Wadjra Karur, which is within nine miles of Gundakul Junction, Madras Railway, is the native Indian term for "Village of Diamonds;" it has for years been known, as its name indicates, as a district where diamonds have been found. These, however, have not been the result of scientific working by machinery, the natives contenting themselves with scraping the surface during the rainy season, or soon after, when the diamonds thus discovered are sold to native princes or dealers in Madras or elsewhere.

Some time since a very large diamond was found at Wadjra Karur,

weighing 67½ carats, and was offered to Messrs. P. Orr & Sons, of Madras, the well-known diamond merchants and jewellers, who, struck with its appearance and size, after consultation with Mr. John Brukowsky, the experienced diamond expert of London and Zurich, purchased it, and having made enquiries, they decided to jointly purchase the lands and mining rights at Wadjra Karur herein referred to. Accordingly, negotiations were set on foot, and some idea may be formed of the labour involved in this when it is stated that there are 44 deeds of conveyance from nearly as many native owners. The legal titles have been examined by the eminent firms of solicitors, Messrs. Barclay and Morgan, and Messrs. Wilson and King, of Madras.

The circumstances under which Mr. John Brukowsky advised and joined in the purchase of the Diamond Fields is best told in the following statement made by that gentleman:—

MADRAS PRESIDENCY DIAMOND FIELDS, LIMITED.—(Continued.)

41, BASINGHALL STREET, E.C.,
LONDON, 9th March 1888.

Some years ago, hearing of the discoveries of diamonds in South Africa, and having been connected with the precious stone trade for the last twenty years, I proceeded to inspect the Diamond Fields in Kimberley and at Jagersfontein. Shortly after this, when at Ceylon, I received a letter from Mr. R. G. Orr, of the eminent Firm of Messrs. P. Orr and Sons, Madras, informing me that a remarkable diamond had been discovered, and requesting me, as a special judge of these stones, to come immediately to Madras and inspect the stone. I then went to Madras, and as soon as I saw the stone I said, "Don't let it go for any amount," and the seller received what he asked for the gem. I at once enquired where this wonderful stone came from, and the seller informed me that it came from Wadjra Karur, and this was confirmed by several natives through whose hands the stone had passed.

The gem above referred to, now known as the Gor-do-Norr Diamond, was sent to Gebrüder Houy and Co., of Hanau, Germany, the diamond cutters, where it was cut and polished, and weighs $24\frac{1}{2}$ carats, and for purity of lustre and brilliancy is said to be unsurpassed by any stone in existence.

I then proceeded to Wadjra Karur, and, to my great astonishment, found the geological appearance similar to the African which I had so recently left.

The hillocks are thrown up evidently by volcanic action; the gravel, the floating reef, and some blue clay (thrown up where wells had been sunk) all proved conclusively to my mind that I was in the presence of probably one of the greatest diamond mines in the world.

I stayed in the neighbourhood for some two months, and the natives from the village brought me rough diamonds, which I bought: and very fine ones these were. Some of these diamonds I sold through Mr. R. E. North, of Hatton Garden, London, and they all realised very high prices, the Indian stones being, on account of their lustre, worth considerably more than the Cape stones.

Mr. Orr, of Madras, had continually been buying stones from Wadjra Karur, and is doing so at the present time. One weighing $18\frac{1}{2}$ carats in the rough, from this field, cut down to $6\frac{1}{2}$ carats, was ultimately sold, through Mr. W. Carlton Wood, for £675, being £105 per carat, to Messrs. Tiffinay, of Paris and New York. Last year I bought some stones from this village, and as an indication of the class and quality of the gems, I may mention that I sold one weighing about $6\frac{1}{2}$ grains to Messrs. Biedermann, of Vienna, for 700 florins.

I may add that, having satisfied myself that the property was diamondiferous ground, I consulted with Mr. Orr, and his firm and myself jointly acquired 554 acres freehold land, or mining rights at Wadjra Karur.

The configuration of the place indicates the basin formation, as well as the pipe, so well-known to South African miners, and if it is opened up according to modern scientific diamond mining, I have the most profound conviction that the results will equal those of Bultfontein and Jagersfontein in quantity, while in quality, stones of infinitely superior lustre and value may be expected.

(Signed) J. BRUKOWSKY.

The above diamond is referred to by Professor Church, M.A., F.C.S., F.I.C., in his South Kensington Museum Art Hand-book, entitled "Precious Stones." He says, the "Gor-do-Norr" has a specific gravity of 3.527; and Mr. R. B. Foote, F.G.S., Superintendent, Geological Survey of India, referring to this diamond, in his Notes on the Geology of parts of Bellary District, says: "Mr. R. G. Orr has now a Wadjra Karur diamond for sale, valued at more than £10,000. It is a large and remarkably fine stone."

The Company has the option of purchasing the Gor-do-Norr diamond on advantageous terms, and offers it for sale at the price of £15,000, which, though leaving the Company a handsome profit, the Directors are assured by competent experts in precious stones is a very moderate price to a purchaser.

The Wadjra Karur properties have been inspected, by request and instruction of Messrs R. G. Orr and J. Brukowsky, by Mr. Andrew Copley, and Mr. R. Bateman Smyth, Mining Engineer, whose Reports are enclosed herewith, and to which special attention is directed.

MR. ANDREW COPLEY SAYS:—"The natives of India, past and present, have shown no disposition to engage in deep mining. It may be that this is why they have not hitherto developed this most remarkable formation. Some of the oldest Cape diamond miners may still recollect that the famous Colesberg Kope—by which name the Kimberley Mine was known in 1870—was rushed and abandoned six times before people realised that they had been coquetting with what is now one of the richest known diamond mines.

"Taking at this time a retrospective view of the whole, I see no reason to doubt (water being abundant and labour cheap) that with proper machinery this property will develop into a valuable diamond-mining industry."

MR. R. BATEMAN SMYTH SAYS:—"The land having been secured without any liability for royalty, and I having tested and conclusively proved the extent and quality, nothing more remains but to open out the Mine in accordance with modern scientific methods. When a shaft has been sunk right down into the blue clay pipe, and the property fairly developed, the result will, in my opinion, be as abundant and satisfactory as the diamond mines of Kimberley and Griqualand West."

It will be observed from the enclosed Report of Mr. R. Bateman

Smyth that the basin or pan at Wadjra Karur covers between 60 and 70 acres, whilst the extent of the Kimberley Mine consists of but a few acres.

So soon as this Company has got its machinery at work, and has proved to the world the value of the Wadjra Karur property, which the Directors are advised will be in about six months, it is the intention to mark it out in blocks, as at Kimberley, and in addition to working, will either form subsidiary companies, or sell or lease portions from time to time on the plan pursued by the South African Exploration Company, whose shares, 10s. paid, now stand at £18 per share.

As to the principal Diamond Companies at work, the profits from holding their shares will be seen by the following table of premiums at which they stand, and the Directors believe there is every reason for the shares of this Company, as a parent Company, rising to a high premium.

Name of Company.	Paid-up Capital.	Paid up per Share.	Present Price.
De Beer's...	£2,510,000	£10	£42
Kimberley Central ...	1,422,950	10	41
New Jagersfontein ...	129,000	10	21
Bultfontein ...	140,000	5	22
United Diamond ...	.....	1	$3\frac{1}{2}$
Klepfontein ...	.....	1	3

The De Beer's Company have just declared a quarterly dividend at the rate of 40 per cent. per annum and the Kimberley Central Company at the rate of 86 per cent. per annum.

India is known as the natural home of the diamond. The Diamond Fields of India have been celebrated from remote antiquity; and, with the exception of Brazil, until the South African discoveries, most of the diamonds in the world came from there, and this without any scientific working on modern principles. The clear blue-white water of the Indian stones has never been equalled either in size or quality, by the output of any other country.

Most of the historical and renowned diamonds have been found in India, and, amongst others, the following:—

Name of Stone.	Weight in the Rough.	Weigh when Cut.
The Nizam ...	340 carats	.....
The Great Mogul ...	$787\frac{1}{2}$ "	$279\frac{1}{5}$ carats
The Great Table ...	.....	$242\frac{5}{8}$ "
The Regent ...	410 "	$136\frac{1}{4}$ "
The Austrian Yellow ...	.....	$139\frac{1}{4}$ "
The Koh-i-noor (the Property of Her Majesty) ...	193 "	$102\frac{1}{2}$ "

and now from the Wadjra Karur Fields, before they are opened out, another is given to the world, viz., the Gor-do-Norr, surpassed in quality, brilliancy and purity by none of the above, but superior to most of them.

The amount to be paid for the Freehold Land and Mining rights is £1,60,000, payable in shares of the Company to be issued as fully paid up. This will leave ample working capital.

The Directors do not think it necessary to add to the above statements, except to draw the attention of intending investors to the small amount of the Company's capital as compared with the existing diamond companies, and to the enormous possibilities consequently in favor of the shares when further discoveries are from time to time announced.

The following contracts have been entered into, viz., dated 15th March, 1888, between Robert Gordon Orr and John Brukowsky of the one part, and Charles Henry Strutt of the other part; dated 17th March, 1888, between the same parties; dated 16th March, 1888, between Robert Gordon Orr of the one part, and Charles Henry Strutt of the other part; dated 17th March, 1888, between Rowland Bateman Smyth of the one part, and Charles Henry Strutt of the other part; dated 15th March, 1888, between Charles Henry Strutt of the one part, and Wilfred Hargrave of the other part; dated 9th April, 1888, between Charles Henry Strutt, the Vendor, of the one part, and Alfred William Browning, on behalf of the Company, of the other part.

The Vendor, who is the promoter, will pay all expenses attending the incorporation and registration of the Company, and also all underwriting, brokerage, commissions, printing, advertisements and expenses attending the issue of the Company's capital up to and including the first allotment. These and other arrangements which have been entered into by the Vendor with various persons, may technically constitute contracts within the meaning of the 38th section of the Companies' Act, 1867. Applicants for Shares must therefore be deemed to waive the insertion of dates and names of the parties to any such arrangements or Contracts, and, in order to prevent any questions, must accept the above statements as a sufficient compliance with Section 38 of the Companies' Act, 1867, and applications for Shares will be received subject only to this provision.

With reference to the above announcement, the Company having proceeded to allotment of shares in London, THE COMMERCIAL AND LAND MORTGAGE BANK, LIMITED, MADRAS, is authorized to receive applications for 2,000 shares (reserved for subscription in India) in the MADRAS PRESIDENCY DIAMOND FIELDS, LIMITED. The Rupee value of a share is Rs. 75, Rs. 30 being payable on application, further calls of Rs. 15 each being made as required, at intervals of not less than one month. Allotments in Madras will be made in order of application, telegrams taking precedence; the subscription list will be closed on Saturday, 16th June. Currency Notes of any Circle and Cheques on Indian Banks received at par.

Cheques on England also accepted if more convenient to subscribers. Forms of application and copies of Articles of Association obtainable from the Commercial and Land-Mortgage Bank, Madras, and from P. ORR AND SONS, Agents, Madras.

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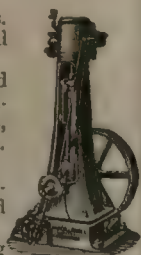
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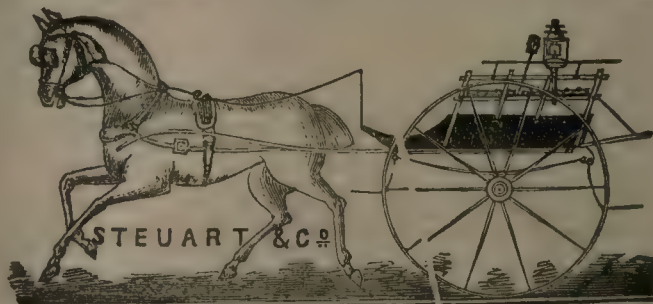
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ANSWERS TO CORRESPONDENTS.

TEDDY.—The subject has already had as much publicity as it deserves.

INDIAN ENGINEERING.

SATURDAY, MAY 26, 1888.

THE BOMBAY P. W. D.

A RECENT notification in the Bombay Government Gazette that Mr. J. E. Whiting is to act as Chief Engineer for Irrigation, with the title of Chief Engineer, Central Division, looks like the first step in Lord Reay's long expected scheme for the re-organization of the Public Works Department. It is believed that the scheme is to confine the duties of the two Chief Engineers to those of Superintending Engineers of Divisions, and to vest the control of the Department in the Secretary to Government acting directly under the Governor. By this means a reduction of two Superintending Engineers' offices will be effected. We doubt, however, whether this will improve the administration, for the following reasons :—

A large technical branch of the administration like the P. W. Department requires a professional head with full powers. Like, as in the Postal and Telegraph Departments or as for a Railway, there should be a single Director or Manager with undivided responsibility. Unity of administration is not obtainable under a Secretary (however capable) who has to get superior sanction to every order that he issues. It is often also annoying to Executive Officers to receive administrative orders, as it were, anonymously, or at any rate, without knowing who is the actual author of them. Supposing, for instance, the matter sent up for settlement to Government is a dispute on an engineering point between one Executive Officer and his Superintending Engineer. It would be much more satisfactory to have a decision from a Chief Engineer signing in his own name, than by one signing as Secretary to Government.

In carrying out work, too, it makes all the difference whether a man knows the views of his Chief or not. If there is a divided control, like that of a Secretary, it is not safe to depart from the strict letter of the regulations on any account. For the Secretary who never leaves his desk, has nothing but written communications to judge from; whereas a Chief Engineer is probably personally acquainted with the work, and so will be able to consider its real interests. Without a Chief Engineer it is difficult to see how wasteful construction can be put a stop to, for who else is interested in securing economy, or can be entrusted with the duty of keeping down estimates.

The Secretary cannot do it from his office, burdened as he is with Secretariat work, and with a stationary Chief both Superintending and Executive Engineers find it answers better to frame liberal estimates rather than have any trouble afterwards during the execution of the work in accounting for possible excesses. For low estimates mean increased chance of excesses, and an Engineer will not run the risk of these, unless he has a Chief capable of discriminating and helping him to get the necessary extra sanction if required. If the head of the Department is fastened to head-quarters, he will have

to govern by the regulations, and in that case no credit is to be got for submitting low estimates, or for attempting to do cheap work. An Executive Officer will be wiser then to attend rather to the working of his correspondence and to the correctness of his accounts.

The changes we should recommend, therefore, are quite different to Lord Reay's. Granting that a dual control or the separation of the Chief Engineer and Secretary is unavoidable, we would relieve the Chief Engineer of all Secretariat work, and would make him solely responsible for the economical disbursement of the P. W. expenditure. All communications for the Department should pass through his office, while his own orders should be separately distinguished. Then Executive Officers would be able to communicate with their Chief unreservedly, whereas in addressing a Secretary there is the risk of being supposed to be obtruding himself unnecessarily before Government.

DIAMOND FIELDS OF INDIA.

I.

THE history of the earliest find of the queen of gems is enshrouded in mystery, but certain it is, judging from the records of the past, that long before the appearance in the market of the world of either the Brazilian or the African rival, India with Borneo was probably the only source of supply. Most of the historical and renowned diamonds, the Nizam, the Great Mogul, the Regent, the Kohinoor, the Gor-do-Norr, and brilliants of lesser magnitude can trace their illustrious origin to the coruscating tracts of India.

According to recent and more authentic accounts there are in India—omitting unimportant localities—three extensive diamond-bearing tracts which are geographically widely separated from each other.

The first, or the most southern of these, though a misnomer, is that of Golconda in the Hyderabad Territories, whence the Mountain of Light, or the *Kohinoor*, was said to have been obtained. In this tract are also included the districts of Cuddapah, Bellary, Karnal, Kistna and Godavari in the Madras Presidency. Mines were worked in these localities and at Bhadrachellum further north.

The next, or second great tract comprising a considerable area, lies between the River Mahanadi and Godavari. Included in this extensive tract are localities of smaller note, where diamonds have been reported to have been found. These are the neighbourhood of Sambalpore and Wairaghar, and two or three places in Chutia-Nagpur.

The third great tract is situated in Bundelcund Territory, where the famous mines of Punnah and others were extensively worked. The geological formations, which are said to contain the diamond-bearing beds are the Vindyan and Karnal formations consisting of detrital conglomerates, sandstones shales, limestones, blue clay and quartzites. At Punnah diamonds have been found in *situ* in conglomerates and alluvial deposits.

Passing from the brief into a more detailed account of these fields, we will now describe each tract separately, giving, as far as able, particulars as to the cir-

cumstances which have recently awakened so much public attention in the direction of leasing and working of some of these diamondiferous regions, and describing the *modus operandi* which obtained in the olden times under native control and operation.

The diamond-producing centres of the Hyderabad Territory have been under examination by an expert for some time, and the reports are, so far as we are informed, sufficiently favourable to induce the hope that sooner or later, or as soon as the clouds that just now hang heavily in the mining horizon of this State have rolled by, operations in earnest will be undertaken. It was long since the popular belief that the famous Kohinoor was mined or found at Golconda, but later and more careful investigations and historical researches have dismissed this as untenable, since such mines were never known to exist here, but, as a matter of fact, save the halo which the finding of the Kohinoor caused around its name, Golconda had not been known to greater fame than being the old capital of the Hyderabad State.

In the Madras Presidency we find the most important localities are situated in the Bellary and Kurnal Districts, where are noticed the continuation of the diamond-bearing strata which thinly cover the Cuddapah rocks.

At *Wajra Karur*, near Bellary, diamonds have been reported by various observers to have been found, and, as the name signifies, it is indeed a veritable *village of diamonds*.

The circumstances which have led to the formation of the Limited Liability Company, whose prospectus appears in our advertisement columns, may be ascribed to two or three facts, *viz.*, the early notice of the field by Mr. King and Captain Newbold, the find of Gor-do-Norr, and more recently the flattering, though not undeserving, report of an expert—Mr. Brukowsky—who on examination found the geological and physical appearance of the locality identical with the African, which he had visited previously to his coming to *Wajra Karur*. Mr. King entertains the highest opinion of this field, in the proprietary of which he is a co-partner with a member of the well-known Madras firm of Messrs. Orr and Co., and considers it a place of great promise and worth. During his short stay at the village he was further enabled to confirm his opinion by the substantial proof of diamonds in rough being brought to him for sale. Many of these which he purchased were of fine lustre, and realised higher prices than either the Brazilian or Cape diamonds. The configuration of the field indicates a basin formation, as well as pipes generally met in the African area. Messrs. Andrew Coply and R. Bateman Smyth have also favorably reported on the locality which is stated to cover between 60 and 70 acres, and when the property is properly developed the result will be as promising and satisfactory as the mines of Kimberley and Griqualand West.

The notoriety which *Wajra Karur* attained by the find of the Gor-do-Norr is ascribed to a curious incident which happened in Madras five years ago, and which will be found in the prospectus above referred to.

The district of Bellary has always been notable for

this *brilliant*, and the conditions under which the mines were worked by licensees under native *régime* were:—

(1.) All diamond weighing one pagoda and upwards became the property of Government.

(2.) On all others Government received a royalty equal to $2\frac{1}{2}$ per cent.

(3.) A monthly *nuzzar* of one Madras pagoda to be paid for each mine.

It is stated that in 1770 the revenue from this last source amounted to Rs. 50,000, and in 1803—1883, when the district was ceded, the sum realised from 30 mines then in operation did not amount to more than Rs. 3,600. Though there is no systematic mining, diamonds are occasionally found and sold in the rough to native dealers in precious stones.

The prices which they formerly realised in the rough condition depended, we find, greatly on the *caste* to which they belonged. Thus a stone of 1 manjely or about 2 carats weight of the *Brahmin* class was valued at £9; one of the *Sudra* class only half that sum; other classes having intermediate values.

In the Kurnal District there are several places which have been visited, and after careful exploration described as diamondiferous. Notably among these are *Banagapally*, Rawalkota, Timapoorum, Deomurrooh, Tandrapad and Buswapur where mining had been confined to rock workings, now deserted; and alluvial washings.

(To be continued.)

CALCUTTA BUSTEES AND HOW TO IMPROVE THEM.

WITHOUT being considered irreverent in the least, and not meaning to draw a comparison which may be construed as impious, we would say that the *fiat* laid down in the Scriptures about the poor being always an appendage to society applies equally to the existence of *bustees*. An Indian town without a *bustee* might very appropriately be compared to the play of Hamlet with the part of the Prince omitted. It is a legacy handed down to the community from time immemorial and we must make the best of it. There is literally no help for these plague-spots but one, and that is, to keep them pure and sweet as the circumstances of the case will permit. We are therefore glad to see that, notwithstanding the vigorous opposition offered to the Calcutta Municipal Consolidation Bill, step by step, by two native members of the Bengal Council, it has been carried through, owing to the strenuous exertions of the rational party in the legislature.

To the credit of the Hon'ble Dr. Mohendro Lall Sircar, C.I.E., however, be it said, that when the question of sanitation came to be discussed, he rose above caste prejudices and sentimental theories, and while his Hindoo and Mahomedan colleagues raised a wail that their cherished traditions would be outraged by the segregation of patients suffering from infectious and contagious diseases, he laughed them to scorn. But then Dr. Sircar is a scientist and a savant, he sees things in their proper light, and not through a distorted medium. We heartily wish India had some more men of light and leading like the worthy

Doctor to explain to his countrymen what is good for them; but we are digressing.

The portion of the new Act relating to regulations regarding huts and *bustees* leaves their present condition untouched, and is only concerned with future improvements. It will be said that the existing arrangements could not well be disturbed without causing serious discontent, but until something is done in this direction it is worse than useless to concern ourselves about the future, as a long time must necessarily elapse before the benefits of the Act could be appreciated. Then again is it not preposterous to suppose that an illiterate, ignorant owner of a hut will go to the expense and trouble of drawing up a "ground plan of the hut to the scale of eight feet to an inch, and such other details as the Commissioners may prescribe." If the improvement of the Calcutta *bustees* depends upon these provisions being carried out to their very letter, that desirable consummation may be conveniently postponed to the Greek Kalends.

Let us go a little more into details and we shall see how far the Act provides for all contingencies. Before building, rebuilding or adding to any hut, the person intending so to do shall give notice to the Commissioners of his intention to do so, and the Commissioners shall either express their approval, or their disapproval of the proposed work on any one or more of the following grounds:—

- (a.) That the site is ill-chosen with reference to adjacent huts or with reference to any present or proposed roads.
- (b.) That the ventilation will be defective.
- (c.) That the arrangements for scavenging or drainage are defective.
- (d.) That the hut will be within thirty feet of a tank.
- (e.) That the hut will be on the site of a tank, which has been so recently filled up as to be prejudicial to the health of a person dwelling in it.
- (f.) That the plinth is not two feet above the level of the centre of the nearest street.
- (g.) That the erection of the proposed hut will infringe some specified bye-law made under this Act.

One cannot help remarking that these elaborate precautions against a perpetuity of nuisances are lost upon those who are the objects of such solicitude on the part of the Commissioners. Every one acquainted with the intelligence of the average *bustee-wallah* will not fail to observe that the grounds of rejection are placed at a high standard. Leaving everything aside for the present, we would ask what have the Commissioners done to discourage the state of affairs indicated in clause (e). So far as we are aware, we are justified in saying that as a rule huts have been, to our knowledge, erected on the site of a tank long before the tank was completely filled up. As an instance in point we would cite the case of a pond in McLeod's Lane, which was hurriedly filled up about 10 years ago, and, as a consequence, cholera raged virulently in the neighbourhood long before they had ascertained the cause. But this was not very far to seek; as huts were being erected upon the site of the tank they were sink-

ing fast enough in it. There was an attempt made to throw more refuse, but it was of no use—there was no solid ground to rest upon. The result was, as stated above, the disease ultimately extending even to Park Street and Park Lane. Year after year we are treated to such exhibitions, and notwithstanding the long winded speeches made in the meetings of the Local Municipal Corporation, everything has remained *in statu quo*.

In the last article on the subject of houses and buildings we said that the penalty clauses of the new Act would weigh heavily on the rate-payers. In the case of owners of huts and *bustees* we feel certain they are more oppressive. Section 249 says that in addition to the powers given to Commissioners to demolish the hut of the poor man, he would be liable to a penalty of "a fine not exceeding Rs. 100 for any such offence, and to a further fine not exceeding Rs. 20 for every day during which the offence is continued after he has been convicted of such offence." Should a tyrannical provision like this be permitted to encumber the Indian Statute Book? Look at the other picture, if the Commissioners shall fail to pass orders within thirty days for the erection of a hut the owner of the hut shall be entitled to receive compensation at the rate of one rupee per diem;

¹ 'Tis strange there should a difference be,

² Twixt Tweedledum and Tweedledee

But to give the Commissioners power to exercise control over the *bustee* lands, it is enacted that they must acquire the whole, or any portion of them, by purchase or under the provisions of the Land Acquisition Act, 1870, or any similar Act for the time being in force for the acquisition of land for public purposes. The contingency of a difference arising between the owners of a *bustee* in submitting a joint plan, is satisfactorily disposed of by the Commissioners themselves drawing a plan and levying a charge not exceeding Rs. 3 per bigah, as the Commissioners in meeting may determine. This will invariably be the case, owing to the ignorance of owners of *bustees*, and the Commissioners would have to decide the point in every instance.

There is another power given to them which, if exercised with discretion, cannot but be productive of incalculable good, but speaking from past experience, it might prove a source of oppression. It is the following—"The Commissioners may, at any time, by paying compensation to the owner of any hut not in conformity with the standard plan, require him to take down his hut, and rebuild it in conformity with such plan." Compensation in such cases is so inadequate that it will certainly give rise to bickerings, but even if this were satisfactorily settled, where is the utility of rebuilding one hut where the whole *bustee* requires thorough cleansing. If a proper price be paid there would be no further cause of alarm to the *bustee* owners. The spirit of section 259 is very wholesome, and it should be applied without much restriction. It gives authority to the Commissioners to carry out works at their own expense if the proprietor of a *bustee* or hut is too poor to pay for the same; if this could be extended to the cleansing of *bustees* nothing more would be desirable on this score.

Notes and Comments.

A DEFICIT.—The last issue of the Local Government Gazette contains a Resolution on the Provincial and Local estimates for the year 1886-87. We find that the receipts of the Thomason College, Roorkee, shew a serious falling off, amounting to Rs. 1,24,000, and that this is at present the subject of enquiry.

COAL PROSPECTS IN ASSAM.—We are glad to learn that the investigations referred to in our last have been crowned with success. The expert confirms the discovery of two seams of good coal 50 miles down the river from Debrooghur. The only drawback is the steep incline of these coal measures, which will render the mineral difficult to work.

THE TANSÁ WATER-WORKS.—Mr. C. E. Hawkes, A.M.I.C.E., has been appointed to act as Assistant Engineer in charge of dam construction at Tansa, on a salary of Rs. 750 per mensem, inclusive of all allowances, during the absence of Mr. MacEwen, on fifteen months' sick leave, from such date in June next as he may avail himself of the leave, or until further orders.

PUBLIC WORKS IN MYSORE.—A contemporary declares that never before in the history of this Province was such an importance attached to the Public Works improvements as now. The Durbar attach much weight to the proper management of this branch of the public service. An allotment of seventeen lakhs of rupees have been made for Public Works out of the Provincial funds.

RAILWAY INSPECTIONS.—Mr. G. E. Moore, Deputy Consulting Engineer, has returned to Calcutta after inspecting the Jorhat and Debru-Sadiya Railways lines in Assam, and Colonel Jopp, Deputy Consulting Engineer, has left Calcutta for Rangoon in the place of Colonel LeMessurier, Consulting Engineer, to pass the recently completed portions of the Toungoo-Mandalay Railway.

BRIDGES FOR THE SOUTH INDIAN RAILWAY.—A number of pin bridges of the Murphy Whipple type are being made from the designs of Sir Douglas Fox, M. Inst. C.E., for the South Indian Railway, by the Butterley Company, Derby. The Butterley Company has provided special appliances for the proper formation and accurate boring of the holes in the links at the assigned distances apart.

THE MADRAS HARBOUR WORKS.—The Chairman of the Madras Harbour Trust has addressed a strong representation to the Government on the question of the harbour works, urging absolute necessity of the north-east entrance instead of the eastern entrance as proposed by Mr. Parkes, the Consulting Engineer, who lives in London and draws £500 a year, and whose theories have been unsatisfactory when put into practice. The Board agitates for more local control, as local Engineers are quite competent to complete the work, but the Government in reply alludes only to financial questions, and does not allude to the question of the ability of Engineers. In the meanwhile the Board has accepted Mr. Thorowgood's resignation with regret.

ARCONAM JUBILEE MEMORIAL.—This memorial, which has been in course of construction for some time past, is now completed. It consists of a granite square base with angular buttresses surmounted with four lamp standards. Between the four buttresses are four tablets containing inscriptions in English, Telegu, Tamil and Hindustani, surmounting these is an octagonal obelisk, headed with a carved hooded cap. The whole of the work is in fine polished Sholinghur granite. The

memorial was designed by W. N. Pogson, F.S.A., Architect, Madras, under whose superintendence the work has been executed by Messrs. Ostheider and Co., the four lamp standards being furnished by Messrs. Richardson and Cruddas of Bombay. The total cost has been Rs. 1,000.

IRRIGATION WORKS IN THE MERV OASIS.—A special commission has been formed in the Department of Appanages to carry out the projects for an irrigation bund, canal heads and locks in that part of the Merv oasis which has been constituted an Imperial domain. The bund across the Murghab will be constructed at a point opposite the village of Sultan Bend, 75 versts from the city of Merv. It will be carried right across the river and will be about 32 feet in height. The canal heads the locks and a regular network of irrigation cuts will distribute the water collected by the bund over the country to the north of the river; at the same time irrigating in time of summer drought the lands already culturable. The bund itself will be made of an embankment of earth; the canal heads and locks will be made of masonry. A sum of 300,000 roubles will be spent on the works during the current year.

ROORKEE COLLEGE EXAMINATIONS.—We have already referred to the results of the examination held in March last as regards the Engineer Class. It is not a little surprising to find that the student who obtained the highest number of marks failed to obtain the higher certificate of qualification as Assistant Engineer, and therefore lost the Council of India Prize of Rs. 1,000—awarded to the most distinguished student. To qualify for the *higher* certificate the required marks are not less than *one-half* in each of the ten subjects of examination, except higher pure mathematics, in which *one-third* is sufficient, and *three-fifths* the whole. The disparity between the totals of the first two students is comparatively nothing, and the Prize List shews that they were pretty nearly equal as regards merit. As far as we are aware, it is the first time in the history of Roorkee that the *first* man has failed to obtain the Council of India Prize.

P. W. D. CHANGES IN BURMA.—It has been deemed advisable to amalgamate the 6th and 7th Divisions of the Toungoo-Mandalay Extension. The office staff thereafter allowed will be that sanctioned for one Division. The following transfers have been arranged by the Engineer-in-Chief in consequence of the proposed amalgamation, *viz*:—(1) that Mr. Lucksted, Executive Engineer attached to the Burma State Railway, shall hold charge of the open line from Pegu to Pynmana, and he will be directed to take over the 1st Division of the Toungoo-Mandalay Extension ere long. (2) Mr. Chadwick is to remain attached to the Division and is required to give Mr. Lucksted all possible assistance in finishing the work and winding up accounts, since the accounts must be put in perfect order. (3) Mr. Salmond has taken over charge of the 6th Division from Mr. Owen and of the 7th Division from Mr. Dibblee, who goes on leave.

KHOJAK RAILWAY.—Two separate problems confront the Chief Engineer, Mr. F. L. O'Callaghan, who has been entrusted by Government with the design and execution of the works. The first is of course the main through Railway which is to open the way to Kandahar, and which is nowhere to have a curve sharper than 800 feet in radius or an incline more severe than one in forty, so as to enable ordinary engines to ascend the ghât. The second is the supplementary problem of being prepared

to throw troops and munitions, rails, rolling-stock and fuel over the summit, if the need should arise before it is possible to pierce the range. In respect to the first, we learn that the location has been so skilfully selected that singularly few heavy banks and viaducts appear in its course. The tunnel has been taken through the thinnest portion of the chain and is for a double line of rails. It is on an easy gradient for the greater part of its length. As regards the second, the difficulty will be met by "in-clines" worked by winding engines.

STRANGE BUT TRUE!—The *Pioneer*, discussing the Kojak Railway, says:—For the carrying out of this great work there are five Engineers in all on the spot under the orders of the Chief Engineer, Mr. F. L. O'Callaghan. They are living in tents at present, though temporary quarters are in process of erection. The life is one of heavy responsibility and constant exertion. A mistake in their work of a few feet in the levels, or the least error in the direction of the alignment, would involve the complete loss of lakhs of rupees. The lives of the workmen and of future passengers depend on their skill and precautions, and we must express our admiration for their skill, energy and self-sacrifice, and for the loyalty with which their work is done for the Government of India. And yet on this very work the two senior officers in charge, men over 33 years of age, and of ten and eleven years' service, are worse off as regards pay, furlough, leave and pension than if they had entered the Staff Corps or the Indian Medical Service.

VOLUNTEER HEAD-QUARTERS, CALCUTTA.—The question of providing a Head-Quarters building for the Presidency Volunteers is still unsettled. Several plans have been drawn up, but whichever is to be adopted will have to be based upon the iron-work which in an energetic moment was ordered from Messrs. Main & Co. of Glasgow. It is unfortunate that no scope is left for a picturesque design, as the large roof and the temporary nature of the structure practically shuts out any chance. The difficulty, we understand, is primarily one of funds, as the amount now in hand, added to the grant from Government, is insufficient to cover the cost of a building of the size which the already purchased iron-work has been constructed for. Now is the opportune moment for enthusiastic individuals and firms interested in the defence of the town to come forward and increase the available funds. Meanwhile the scheme has been put into the hands of Mr. Gwyther for shaping into form, in order to expedite its acceptance by the Local and Imperial Governments.

R. E'S. AND C. E'S.—AGAIN.—We recently published a "Resolution" relative to the grading of R. E. Subalterns on their first appointment to the P. W. D., the object of which was to overcome the disadvantage they labor under in comparison with Engineers appointed from Cooper's Hill. It was considered that the two classes *would be placed on an equality* by allowing the R. E's. to count their *departmental* service as commencing 2½ years after date of first commission. So far the "Resolution" is very plausible, and the concluding paragraph regarding "seniority" and "merit" in the matter of promotion makes it more so. But it appears to us that the principle of equality might equitably have been carried further, and the C. E's allowed to draw an allowance equal to the "Military pay" proper *drawn in addition* to departmental pay by the R. E's. That there has been a divergence of opinion the Resolution clearly

shews, and as it will be instructive to view the question in all its aspects, we purpose dealing with it later on.

THE SPECIAL OBJECT OF THE GLASGOW EXHIBITION.—It is probable that very few persons in India, outside of the Calcutta Chamber of Commerce, are aware of the origin and actual scope of the approaching Glasgow International Exhibition. It has been a long cherished idea in the minds of members of the Glasgow and Calcutta Chambers, that an effort should be made to divert some of the enormous trade between the City of Palaces and London and Liverpool to the good city of Glasgow, whose docks and warehouses are not half occupied by shipping and goods, and where it is contended work can be conducted on a far more economical scale than in either of the English ports. It is desired to form and extend a direct trade between Glasgow and Calcutta, as well as with other eastern and colonial ports as opportunities offer, and it was felt that the initiation of an Exhibition on a large scale might forward this object. This being the idea, special prominence will be given to the Indian, Canadian and Ceylon sections of the Exhibition.

BOMBAY PORT TRUST.—The Engineer in forwarding the final certificate granted to Messrs. Kirby and Co., amounting to Rs. 1,57,378-6-2, made up from the final measurements, all having been agreed to by Messrs. Kirby and Co., states that on payment of this amount and on making over the retention, amounting to 1½ lakhs of rupees invested in Port Trust bonds, all matters between the Trustees and Messrs. Kirby and Co. will have been completed and determined in connection with contract No. 1, Wet Dock Extension, dated 21st March 1885. The Engineer states that the final payments are less by about ¾ of a lakh of rupees than the total of Messrs. Kirby and Co.'s tender, notwithstanding the extra cost in—(1) Widening bay of communication passage; (2) Widening sea entrance; (3) Foundations of 110-ton crane; (4) Portion of sub-way along walls and all the sub-way across roots of jetties; (5) Extra depth to which it was necessary in some cases to go for foundation, in some cases more than 10 feet; (6) Other smaller items such as foundations of gate machines, bridges, &c., &c.

THE TANSÁ WATER LOAN.—The Bombay Municipal Corporation at their meeting on Monday last, considered the Government of India's letter refusing to allow the Tansa Water Loan to run for a period of sixty years, and ordering that for the future no money is to be borrowed by the Municipality for a longer period than for forty years. Major Selby proposed that the papers in connection with the question he referred to a Committee, with a request that they would draw up and submit to the Corporation a letter on the subject for submission to the Government of India, and Her Majesty's Secretary of State in Council of India, the Committee having the power to call for Municipal persons and papers, and to consult the Chamber of Commerce, or any other body or persons that they might think fit. Major Selby, in his speech upon the above resolution, observed that the Corporation ought not to accept the proposal of the Government of India without a strong and earnest protest being made against it. The corporation unanimously adopted the resolution.

RUSSIAN PROGRESS IN CENTRAL ASIA.—Railway construction in Central Asia is to be carried on during the coming summer with renewed vigor towards

both the Indian and Chinese frontiers. Russia is determined that no commercial or military advantages to be derived from easy and rapid communication throughout her vast Asiatic territories shall be lost for the sake of a few millions of roubles or pounds sterling. The political influence which she will also acquire over the people is not among the least of the results that will accrue from the energy and undoubted ability which General Annenkoff has displayed in overcoming the obstacles to his enterprise that were believed to be insurmountable. The approach of the Russian railways to the frontiers of China cannot fail to alter very materially the relations between the two countries, and the statesmen at Peking will need all their tact to meet the new danger threatened by the aggressive energy of the Russian military engineer on the borders of their far-away Western Provinces.

THE BENGAL P. W. D. SECRETARYSHIP.—It was generally expected that the *Gazette of India* issued this week would have notified the appointment of Mr. E. J. Martin to officiate as Chief Engineer of Bengal. It is no exaggeration to say that the majority of Engineers in the Province have looked forward with keen interest at the extent to which this worthy officer's claims have been considered, and it will be an event upon which the Bengal Engineers will congratulate themselves when Mr. Martin has been placed upon the seat which he has well earned by long, varied and exceptional service. The appointment of a Civil Engineer to an important Secretaryship is always a matter of intense interest to Civil Engineers all over the country and should be of equal import to all members of the profession, particularly when the promotion is regulated both by seniority and merit. But we are sorry to find that some of the "military element" are not disposed to take the same view of things, and that a gallant R. E. has some "Leave" ready and available to provide against the contingency of having to serve, as No. 2, under a C. E.

R. E. LEAVE AND FURLOUGH RULES.—In view to the removal of any misapprehension as to the furlough and leave rules applicable to officers of the Royal Engineers serving in India, it has been notified that (1) officers belonging to the late Indian cadres and non-continuous service officers of the Imperial list who were posted to the Indian establishment on or before the 11th March 1886, come under the furlough regulations of 1868, if in permanent Staff or departmental employ, or if belonging to the fixed establishment of the corps of Sappers and Miners; but if not on the fixed establishment of the Sappers and Miners or in permanent Staff or departmental employ, they come under the leave rules applicable to officers of the British Army in India. (2) Non-continuous service officers of the Imperial list, who were posted to the Indian establishment after the 11th March 1886, come under the leave rules applicable to officers of the British Service in India, however they may be employed; and (3) continuous service officers of the Imperial list come under the leave rules for the Staff Corps, if in military employ, but under the civil leave rules if in civil employ.

THE SIND-PESHIN RAILWAY.—The recent issues of *Engineering* give some very interesting (*interested?*) articles on the Sind-Peshin Railway, pointing out the difficulties encountered during the construction. Condensed, it states that in the summer the thermometer registered 124° Fahr. in the shade, and in the winter fell to 18°

below zero. The cholera raged, carrying off thousands of victims. Food there was none on the spot, water was often absent for miles, and timber and fuel were unknown. Added to this the few inhabitants the region possessed were cut-throats by profession, and amid such surroundings a line 223 miles long ascending in 80 miles to an elevation overtopping Mont Cenis and St. Gothard, and then crossing a summit of 6,600 feet was constructed. The work was pushed on with feverish haste to satisfy the wishes of a Viceroy who had a Pendjeh incident unsettled on his hand, and found himself with a broken link in his chain of attack within possible distance of the greatest struggle England ever had entered into since the Napoleonic wars. The articles are a tissue of eulogy and appear to us to be drawn up in a "defensive" strain.

AN INLAND DOCK FOR MADRAS.—Mr. Cecil Scott, A.M.I.C.E., Kistna Local Fund District Engineer, recently wrote to the Madras Government complaining that a proposal made by him for an inland dock at Madras did not meet with the attention it deserved. He says: "I can understand that to desert the so-called harbor, which, after many years' hard work and enormous expenditure, is still to be *carefully avoided in bad weather*, and to commence anew on a dock which would, with its entrance, be finished in two years (for many portions could be at work simultaneously), may, from a money point of view, seem highly unpleasant, and the man who recommends it troublesome." The Government observe that Mr. Cecil Scott's scheme for an inland dock for Madras was transferred to the Harbor Trust Board for disposal in August 1886, and that the Board, after obtaining the views of the Port Officer, were of opinion that the then state of the harbor rendered consideration of the subject premature. The circumstances have not materially altered since, but the Governor desires that the Board will be so good as to state whether they have any further remarks to offer on Mr. Scott's scheme. The Board have no further remarks to offer.

THE CONSULTING ENGINEERS' BRANCH.—We learn that the "powers that be" have ruled that no more C.E.'s. are to enter this Branch of the P. W. D. It is averred that too many such have been appointed to it of late, and the initiative has been taken by the appointment of Lieutenant Shelly, R.E., *Assistant Engineer, 1st grade*, three years' service, Military Works, to do duty in the office of the Consulting Engineer, Madras. This may go far to explain why the Government of India in the P. W. D. have *now* come to consider the grade of Superintending Engineer too high a status for a *Deputy Consulting Engineer*. But it will not account for the fact why Major Coaker should get the Consulting Engineership of Madras when he is departmentally junior to Mr. MacGeorge. We notice that most of the Consulting Engineers are high up in the List as Chief or Superintending Engineers, and the question arises how are their successors to be found if the Deputies are junior officers? Under any circumstances, a minimum period of five years' employment on Railway construction should be a *sine qua non* for admission into the Consulting Engineers' Branch, and it will be a great mistake if such qualifying service is ignored or neglected. The days have gone by when an Addiscombe or a Woolwich cadet could sit in judgment on a Sibley or pronounce on the work of a Bruce or a LeMessurier.

Current News.

THE expense of the Gomal Pass survey expedition amount to close upon sixteen thousand rupees.

A NEW steamer was launched at Dallah, Rangoon, lately, and was christened *Ava* by Mrs. Crosthwaite.

LAND is to be taken up immediately for the construction of a military cart-road from Pabbi to Chappri.

THE number of men of the Royal Engineers trained as submarine miners is, we hear, to be largely increased.

THE Ahmedabad Municipality have adopted the drainage scheme recommended by the Sanitary Commissioner.

It is proposed not to open the Toungoo-Mandalay line for passenger traffic beyond Pyinmana until about the 1st January next.

A COMMITTEE will shortly sit to consider the status, grading and pay of the members of the late office of Director-General of Railways.

THE question of the repair of the Chauburji Mosque at Delhi, at Government expense, is now under the consideration of the Public Works Department.

THOUGH of small value at present as a source of revenue, the jade mines of Burma are of importance as yielding one of the principal articles of overland trade with Western China.

COLONEL A. J. FILGATE, R.E., Accountant-General and Deputy Secretary to the Government of India in the Public Works Department, is granted furlough out of India for two years.

THE new line to Bezvada is expected to be open for passenger and goods traffic about the middle of next month, before which time it will be inspected by the Consulting Engineer for Railways.

MR. R. W. BARLOW, Chairman, Harbour Trust Board, has submitted and obtained the sanction of Government for Rs. 29,881 for repairs to the iron screw pile pier in the Madras Harbour.

DEPUTY SURGEON-GENERAL HEWLETT, C.I.E., who has been Sanitary Commissioner to the Government of Bombay since 1881, retires from the service, and is succeeded by Surgeon-Major Collin MacRury.

THE Patiala Council of Regency have arranged for the yearly submission to the Public Works Department of statements shewing the working of the Sirhind Canal in their territory; as also have Jhind and Nabha.

MR. BAKER, the Engineer who recently examined the Mulagori route to Lundi Kotal so frequently advocated in these columns, believes that it is practicable to make a good road though not along the present hill track.

WE regret to announce the death at Netley of Surgeon-Major F. S. B. Francois de Chaumont, Professor of Military Hygiene at the Army Medical School—a man well known and much respected as much in India as in England.

At the meeting of the Nerbudda Coal and Iron Company, Limited, on Tuesday, Mr. S. J. Wilde, the Chairman, said they met on that occasion on more favorable circumstances, and their prospects are better than they have been for many years.

COLONEL C. J. SMITH, R.E., the Consulting Engineer for Railways, Madras, proceeds on furlough in June for eighteen or twenty-four months, and Major Coaker will act as Consulting Engineer for Railways and Joint Secretary to Government, P. W. D., Railway Branch.

POONA proposes to hold an Exhibition of Native Arts and Industries in October next. Such exhibitions should be occasionally held in all parts of the country to offer encouragement to Native arts and manufactures. Municipalities should inaugurate such exhibitions to the largest extent possible.

WE understand that for the benefit of Indian Agriculturists, Mr. Eliot, of the Meteorological Department, has made a forecast of the coming monsoon on the basis of all the information available up to the end of April, the result of which was to have been published in yesterday's Simla edition of the *Gazette of India*.

HIS HIGHNESS the Thakor Sahab of Morvi is intent on completing his railway system. This time next year we shall possibly see Rajkot connected with Wadhwan by his line. This will be a great boon to travellers. It is owing to the enterprise of His Highness that one can travel as far as Vankanir now from Wadhwan with comparative ease.

IN reporting the results of their quarterly inspection of the Kidderpore Dock Works, made on the 2nd May, Messrs. Wickes and Cloete state:—"We consider that the progress on the works which have been taken in hand has been extremely satisfactory, and that, so far as we could judge from a quarterly inspection, the arrangements were good, and the quality of the work all that could be desired."

MR. BRUCE FOOTE sees with surprise that the Resident Engineer in India "of the Madras Diamond Fields," Mr. Rowland Bateman Smyth, is designated as "late of the Geological Survey of India." Mr. Smyth was never a member of our Geological staff, but was merely employed temporarily to look after borings for coals. He has, therefore, no right whatever to the designation chosen.

ABOUT 3,300lbs. of blasting gelatine, a large quantity of Bickford's fuse and other materials of a highly explosive nature belonging to the defence works at Steamers Point went off at Aden the other day, causing a terrific shock. Some shells, weighing about 250lbs. each, were blown a distance of nearly a mile. The accident is thought to have been caused by lightning. No one was hurt.

THE report of the Directors of the Bombay Gas Company Limited, for the half-year ending 31st December, states that, after transferring £7,000 to exchange equalisation account (thereby raising it to £8,479), and £500 to reserve fund for depreciation of plant, &c., there is a profit balance of £9,756, out of which they recommend a dividend of 4 per cent. (making $7\frac{1}{2}$ per cent. for the year), tax free, £156 being carried forward.

THE *Morning Post* says that Simla's "white elephant" has a most insatiable appetite for money. Estimated to cost less than two lakhs of rupees, the ugly structure has swallowed up almost twice that amount; and yet it calls for more. It is now urgently in want of another ten thousand to keep the rain out, and if an application has not already been made to the Punjab Government for sanction to devote this sum to the purpose, that long-suffering Administration may expect one at no distant date.

THE Municipality of Masulipatam have submitted a scheme to Government of a proposed line of Railway direct from Bezvada via the taluq town of Gudivada, a distance of 50 miles. But the Municipal Board of Guntur claims to possess the more eligible route on the Bellary-Kistna which would run in an eastwardly direction to the seaport of Bapatla, a distance of 30 miles. The Guntur scheme also includes a plan for extending the Buckingham Canal from Pedaganjam to Bapatla, distance 25 miles south of that fort.

MUCH progress has been made of late with the new buildings near the Pettah, destined for the location of the Bangalore Woolen, Cotton and Silk Mills. Nearly all the heavy machinery has been placed and expert hands are busy putting up the spindles. The Engines are very fine pieces of machinery, the boilers being supplemented by some new pattern machinery which will economise the consumption of fuel. It is expected that steam will be got up in about six weeks hence, and the new mills will then, or very soon after, be in full working order.

SOME enterprising individuals in Darjeeling are beginning to doubt the wisdom of sending Tibet wool all the way to Calcutta and England to receive back manufactured articles and pay a heavy price for it, when the raw material could be utilised more economically nearer home. They propose to start a mill in the vicinity of that hill sanitarium to convert the wool into Angoras, tweeds, &c. With the example of Japan before them they hope to secure a good business before long, and they are not extravagant in their calculations nor is the idea utopian.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

"BREACH OF FAITH."

SIR,—Referring to your comments on the unjust treatment of Subordinates in Burma, allow me to point out that no better fact can be quoted to show the uselessness of Upper Subordinates that are transferred to Burma from India than what is taking place on the Toungoo-Mandalay Extension, as the Engineer-in-Chief is getting rid of his Indian Upper Subordinates as fast as the various sections approach completion while he is unwilling to give up any of the men that were lent from the Provincial Establishment of Burma, though it is understood the services of these men are wanted for Provincial Works.

JUSTICE.

TABLES FOR ROLLED IRON BEAMS.

SIR,—I am glad that Lala Ganga Ram intends to re-issue his tables in a revised form. There is certain to be a large demand for a good set of such tables, but if his revision is restricted to the lines indicated by him in your issue of 28th April, he will only partially supply it.

The formulæ quoted from Trautwine and Stoney may be all very well for approximate calculations, but they are hardly good enough to found tables upon. The constants given are only correct within certain limits, and, as these are not stated, the formulæ are not of much general use. Lala Ganga Ram assumes that these limits are those laid down on practical considerations in his letter above referred to, but his tables will fall short of the requirements of the profession if he restricts them to these limits. Other practical considerations often dictate the use of beams whose breadth is not between $\frac{1}{8}$ ths and $\frac{1}{4}$ ths of the depth, and that manufacturers roll and dealers import such sections is proof of this, if proof be needed. It is also absurd to say that the depth may not exceed $\frac{1}{4}$ th of the span. If the beam is likely to fail laterally, it can be stayed.

The fact is, and there is no getting over it, that no formula for transverse strength or stiffness is of any use unless it includes the moment of inertia in some form or another, and the more explicitly this function of the section appears, the more general is the applicability of the formula to the various conditions which occur in practice. Men shirk this fact because the calculation of the moment of inertia is a troublesome arithmetical or graphical process, and the full data for its solution are not always at hand. But if it is worth while to compile Tables for Rolled Beams, it is worth while to face this troublesome process, and though, for obvious reasons, the necessary data cannot be fully given in the catalogues, yet they can be readily obtained from the section sheets which any dealer will supply for the asking.

There was a clerical error in the method I gave for finding the moment of inertia as it appeared in your issue of 10th March, and in the letter correcting it, in the following issue, there is a misprint, so it is perhaps excusable that it should not be quite clear. I therefore send it again* using notation without the suffixes which seem to have puzzled the Printer. So far from assuming the web and the flanges to be of equal thickness, the mean thickness of the latter is deduced from the thickness of the web, which, being uniform, is susceptible of exact and easy measurement, and if given, with the other three dimensions, in the catalogues and tables, would indicate the character of the section sufficiently nearly for all practical purposes.

Finally, as to the use of the deflection formula. The permissible proportionate deflection, like the factor of safety, varies with the conditions of the case, and it is incorrect to define a particular ratio of depth to span at which the formulæ used must be changed, unless the conditions are also defined. The designer often wishes to choose these factors for himself, and, if tables are intended to be for general use, facilities should be given for his doing so. This is impossible unless the tables for strength and for stiffness are kept separate, and unless their limits overlap.

Moreover, if the co-efficient of elasticity given in Stoney, page 180 is correct, the modified Trautwine formula does not give the proportionate deflection it is intended to do ($\frac{1}{480}$ th of the span) and its use therefore requires to be justified.

There is much uncertainty as to the proper value of the co-efficient of elasticity which should be used in the deflection formula, and the text books differ much on this point. If any of your readers have access to the results of reliable experiments as to the strength and stiffness of rolled beams, they would do good service to the profession by publishing them or indicating where they are to be found. I believe a very extensive set of experiments has recently been carried out in America, but am not aware where the results are published.

C. W. HODSON.

May 11, 1888.

* Let D, B, A, represent the depth, breadth and sectional area, of a symmetrical rolled beam, and T the thickness of the web, then from these deduce the following:—

$$\begin{aligned} \text{Area of each flange, excluding the web part} &= a = \frac{A - DT}{2} \\ \text{Mean thickness of same} &= t = \frac{a}{B - T} \\ &= \frac{A - DT}{2(B - T)} \\ \text{Distance of centre of same from neutral axis} &= x = \frac{D - t}{2} \\ \text{Then moment of inertia} &= I = \frac{T D^3}{12} + 2ax^2 \text{ very nearly.} \end{aligned}$$

NEW MUNICIPAL OFFICES.

SIR,—I beg to hand you a Circular forwarded by me to all Members of the Bombay Corporation, and would be obliged if you could find room for it in your Journal.

R. F. CHISHOLM.

MR. STEVENS has offered his services to the Municipality to design new offices in lieu of those designed by me some three years ago.

It is hard to believe that the Corporation would undo so much valuable work; that the members would throw to the winds all the pains and trouble taken to evolve the conditions of the competition; and treat the money and time spent on the competition itself as a

solemn farce, by placing themselves unreservedly in the hands of an architect who would not compete because of those very conditions which the Corporation thought proper to frame. I confess that to me it seems most uncomplimentary to the judgment of the members to imagine that they would take such a line of action; and I hope and believe this letter to be wholly unnecessary. At the same time it is but fair to Mr. Stevens to assume that some members of the Corporation have urged him to take this step: hence this letter.

The only objection made to my designs at the outset was one of cost. The experts declared that they could not be executed for the money. My quantities were carefully checked, and found to be correct. Owing to the statements of men who practised locally, I myself had some misgivings about the estimate—misgivings which have been removed partly by actual practice in Bombay, and partly by one of the experts in question undertaking to provide the schedule accommodation, by making additions to an expensive building which cost two lakhs of rupees, for the additional sum of four lakhs of rupees, or for a total of six lakhs.

The next adverse opinion came from Mr. Stevens (then a member of the Corporation, and also an expert), who stated that the competition could not be called an open one, as I was the only architect of eminence who competed. From this period a feeling seems to have arisen in the minds of certain members that they were not getting so good a thing as they might have had; and this feeling has augmented with time, receiving, no doubt, a negative impulse from the silence which I have hitherto maintained, and which I only now break by the advice of friends, because the matter has culminated in an article published by the *Times of India* which advocates the setting aside of my plans and the employment of Mr. Stevens. The principal grounds on which the *Times of India* seeks to set aside my plans are: first, that the competition was not an open one; secondly, that my design being Hindu-Saracenic would not harmonise with the Italian-Gothic Victoria Terminus and the Italian-Gothic Police Courts.

With regard to the first objection, as I did not see the other 16 sets of drawings, I cannot pass an opinion on them, and I willingly leave the *Times* in the hands of the 16 unsuccessful competitors. Touching myself, I would remind the *Times* that I am not a novice in architecture; nor is this the first Indian competition which I have won. As regards quantity, I have up to the present time constructed in India upwards of 18 buildings, each of which cost from 2 to 8 lakhs of rupees, while the number of smaller buildings are too many to enumerate. With regard to quality, I have been placed first in five out of seven important competitions in which I have engaged, and in four of these I have actually received the first prizes. If any other Bombay architect can shew a better list, then the chances of the Corporation obtaining something better than my own designs are very fair.

I must apologise for troubling you with these purely personal matters; but I trust you will see that I could scarcely write fully and avoid them. I pass on, as quickly as possible, to the real point at issue raised by the *Times of India*—the point of "style," around which the whole question revolves. This is a matter of the utmost importance, not only to the Corporation, but to the public at large, and it is right that it should be most carefully considered. The *Times of India* modestly "submits" that "the new Municipal Offices should be in strict harmony, and should mass well with these extensive buildings [i.e., the Victoria Terminus and the new Police Courts]. * A building in the Hindu style of architecture, such as that which won the first prize in the competition, would, in our opinion, be utterly incongruous, placed between two buildings of such an opposite style of architecture." A few lines further on the modest submission is changed to a certainty, the writer declares: "It is a public duty to say that if a building in the Italian-Gothic style is wanted, as is clearly the case, * * * Mr. Stevens should be employed." I would ask permission to digress here for a few moments to remind you that the conditions of competition held out the hope that the successful competitor would be employed to carry the designs into execution, or I certainly would never have put pencil to paper; and that another condition left the choice of style entirely open, provided "it was suitable to the climate." I made out my plans with a full knowledge of what the Victoria Terminus would look like when finished. I see no reason to alter my views now, and if twenty similar buildings were erected near the site, instead of two, they would afford me eighteen additional reasons for adhering to these views.

It is not incongruous to put a building of one style near to buildings of another, and it never has been considered so. In proof of this, I would point to the very Venice from which I believe these Gothic inspirations to be derived. In that city we have on the right hand the Doge's Palace in Gothic style; on the left, St. Mark's Library in classical style; and facing us the Cathedral in Byzantine style; and I have never yet heard a single objection taken to one of these masterpieces as incongruously placed—on the contrary, the variety enhances the beauty of each. I will go further and say that it is almost impossible to cause incongruity between buildings, if they sufficiently differ in style; on the other hand, there may be incongruity in a group of buildings in the same style. In Bombay, for instance, the Rajabai Tower is incongruously placed on the smallest structure of a group all in one style, to the detriment of two of the most beautiful buildings in that group. Again there may be incongruity in the same building. To my mind it is incongruous to mix domes, spires, and low-pitched roofs as they are mixed in the Victoria Terminus. I do not say it is wrong, but it is against the received opinions of thinking minds, working in the same direction through centuries of years; and no other building in the world with which I am acquainted presents such a sky line.

I will now take up the real point at issue—that of style. It would be unfair to discuss too closely the meanings of words, but I take it that in citing "Italian-Gothic" the *Times* alludes more particularly to the Venetian phase of it. When we touch on styles it is almost impossible to carry the argument beyond a mere expression of opinion. Not long since the fierce "battle of styles" was fought out in England, classical architecture was trodden under foot, and pure Gothic (carried frequently to the verge of insane archaeological reproduction) reigned

triumphant! A few years have passed, and what do we find? The new Admiralty being constructed in the style of the old Horse Guards! Indeed, it would be quite within the mark to declare that Gothic is completely dead, except for ecclesiastical purposes, in every spot on earth except Bombay. I am not in any way decrying Gothic. I think the real thing in the right place, if not so refined as Greek, certainly the most beautiful stone art the world has yet seen. I confess when I see an elaborately finished façade, and measure the other parts of the building by the wealth of the exterior surface, it gives me a turn to get behind this display and to find, instead of groined roofs and cunning ribbings, that this wealth of outer wall is a mere skin connected with a very ordinary building by wooden joists and a flat terrace! The University, the Senate House, the apse and chancel of the Cathedral, the booking-office of the new Terminus, are all true and beautiful specimens of art, constructive unity is preserved throughout; we feel instinctively that these are ladies among buildings, requiring no paint or tinsel to set them off. But when we see an elaborate architectural exterior screening a very commonplace and utilitarian interior, we get a turn, as if we had seen a dirty piece of underlinen peeping from the dress of a charming and well-dressed woman. If this skin-deep architecture is Italian-Gothic (and I think it is), and if it is "so clearly the case" (vide *Times of India*) that this is what the Corporation want, let the Corporation declare they have changed their minds, and I will bow and retire. I beg that you will not think from the above that I disapprove of the homely constructive expedients of joists and terraces; on the contrary, I would run all joists beyond the walls in the good old Bombay fashion, and support them by quaintly carved *Falists* and *Shumbums*; or, in other words, I would get as much art as possible out of all constructive expedients without being ashamed of them. Fortunately, I can illustrate by Mr. Stevens' admirable structure what I mean; it is this, that having seen the interior of the building, personally, I admire the back more than the front. The latter may be artistic; it may be lovely; it may be exactly what an Italian (who regards anything and everything as a vehicle for artistic display) would do; it may completely disarm criticism while under actual observation; but it is not architecture according to my idea, and whatever the style may be, it certainly is not pure. The peacocks in the tympanums, the cusplings, the reflex curvature at the apex of many of the arches, the circular ornaments in the string courses and parapets, the battlements, indeed the very dome itself, are all Eastern features, and, with the exception of the latter, to my mind the most beautiful features in the building. If we are to have Eastern features, why not plunge at once into the stream of native art, instead of thus lingering ankle-deep on its edge! And finally, what is the opinion formed by competent critics of the style which the *Times of India* is so anxious to retain in Bombay? Fergusson says, speaking of Italian-Gothic in Italy, "We find buildings scarcely surpassed in size by any others in Europe, the best possible 'construction' is combined with the most beautiful material. The vaulted roofs are of the most daring construction supported by coupled piers; and the pointed arch, on which so much stress is laid, is used currently in every part; and yet with all this, these buildings are only cold, unmeaning, and inartistic productions, with all the defects and hardly one of the beauties of true pointed Gothic Edifices." And Garbett, speaking generally of Venetian architecture, says: "The higher excellences are sacrificed to the lower, true grandeur to pompous effect, intellectual sense of fitness to mere eumorphic beauty, the mind to the eye, self-concealing art to self-displaying art. No wonder that this has been and (perhaps ever will be) the popular style all over Europe!" Let me quote from the former authority a few words about true Eastern art. First, speaking of Hindoo palaces, Fergusson says that, "large or small, all are designed with that exquisite feeling for grace of outline which characterise the Hindoos in all ages," and of the Mahomedans he observes: "The grace and elegance of their architecture has never been surpassed." It is the style resulting from the fusion of these that I selected.

In conclusion, I would remind you that although three years have passed since I obtained the first prize, I have never sought to influence the members of the Corporation until the present moment, and I have carefully abstained from canvassing in any way; and whatever may be the final result, I feel grateful to the Corporation as a body that, in the face of powerful opposition, the voting has hitherto been in my favour.

BOMBAY, May 15, 1888.

Literary Notices.

WEATHER CHARTS OF THE ARABIAN SEA. Calcutta. 1888.

THIS volume consists of a series of Charts illustrative of that portion of the North Indian Ocean known as the Arabian Sea. They show the Mean Pressure, Winds, and Currents in each month of the year, with other information alike scientific and useful.

The area embraced extends from the Equator to the Persian Gulf and the intermediate space between the African and Indian Coasts. The volume is a third instalment of a series devoted to like objects. The data from which the series have been drawn up have been collected by the London Meteorological Office and reduced to their present form at the expense of the Indian Government. The maps have been photo-zincographed at the Survey of India Office and appear to have been compiled by Mr. W. S. Dallas. The explanatory letter press which accompanies them leaves nothing to be desired. The book is handsomely bound in cloth, measuring 24"×18," and bears the imprimatur of the Meteorological Department of the Government of India.

* They are more than a quarter of a mile distant from each other.

General Articles.



RESIDENCE FOR THE JAGHIRDAR OF ARNI.

We illustrate in this week's issue the additions and alterations to the residence of the Arni Jaghirdar. The old building, which is an incongruous pile of poor Grecian architecture, has been enlarged and added to in such a manner as to entirely conceal the old structure. The treatment of the present exterior in free classic architecture has rendered the whole an imposing edifice. The design is by W. N. Pogson, F.S.A., Architect, Madras, under whose superintendence the work will be carried out.

DRAINAGE OF TOWNS BY OPEN DRAINS.

By H. W. HUGHES, C.E.

II.

AVERAGE monthly fall of rain in some towns in Madras:—

	May.	June.	July.	August.	Sept.	Oct.	Novr.	Decr.
Madras ..	2.05	2.01	3.18	4.51	4.81	10.83	13.04	5.03
Bangalore ..	5.14	3.02	3.75	5.86	6.33	5.42	1.67	0.79
Bellary ...	1.22	3.31	0.94	2.82	4.44	2.81	0.69	0.01
Trichinopoly ..	2.46	1.00	2.27	2.66	6.02	5.00	2.53	3.96

The problem that has to be solved in drainage work, however, in reference to rainfall is to convey the greatest amount falling in a short time. Some extraordinary falls of rain have been registered occasionally in India, for instance in the Bengal cyclone of 1874 a fall of ten inches was registered at Midnapore in 24 hours.

At Vizagapatam in 1876 a fall of 15.2 inches was observed in 18 hours.

In 1880 five inches fell in two hours at Tipperah, Eastern Bengal, the *maximum* monthly fall at that place being only as many inches.

In August 1868 an extraordinary fall of rain was observed at Ahmedabad during four days, the register being as follows:—

10th	...	...	5.40
11th	...	...	18.12
12th	...	...	4.87
13th	...	...	0.92

Total in 4 days 29.31 inches.

The maximum quantity that has been registered in Madras in one month is 38 inches, but on one occasion 20 inches fell in 24 hours.

These, however, are very extraordinary falls, and if a system of drains was designed to carry off such immense quantities it would be exceedingly costly, and, moreover, the drains would have to be of such a large section that their efficiency for ordinary purposes would be impaired. Such falls as above indicated do not probably occur more than twice or three times in a century, and it is rarely in the plains of India that the rainfall registered in 24 hours attains even 12 inches.

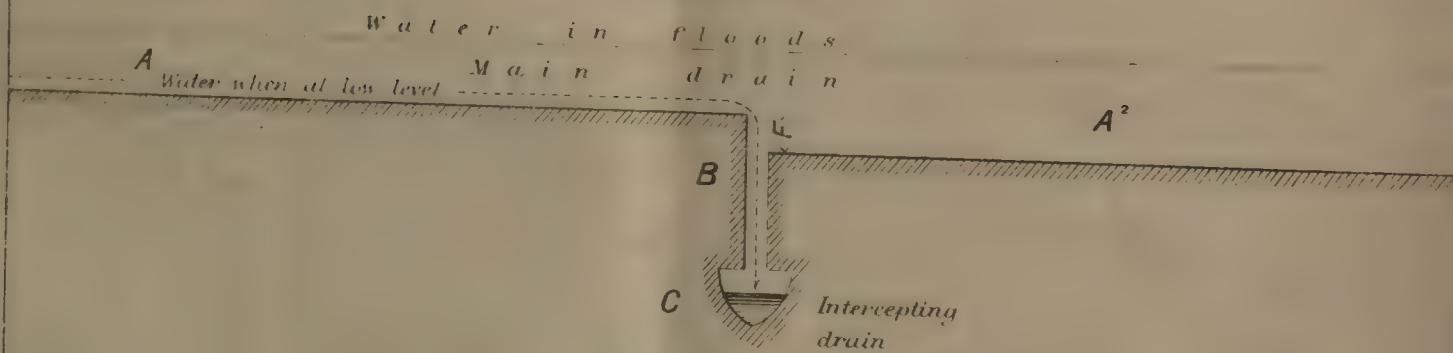
It should also be remembered that the rain water does not enter the drains at the same rate at which it falls, but sometime elapses before all the water reaches them during which the channels are acting in carrying it away from the parts of the drainage area nearest them; if a heavy fall occurs when the drains are almost empty it may

DRAINAGE OF TOWNS.

PLAN OF AN INTERCEPTING DRAIN.



SECTION R S



be a long time before they are flowing full, but on the other hand if a heavy fall comes on immediately after a moderate one the time is much shorter.

The proportion of the rainfall which is carried off by the drains is influenced by many causes, for instance the soil of the locality may be sandy, and it would in that case absorb a large quantity of the water, the streets may be paved or may be macadamized or they may be simply earthen roads with no metalling, the houses may be close up to the drain or at some distance from them, the town may be on an eminence with steep slopes, or it may be on a low flat plain, and many other considerations will present themselves, each of which must be well weighed and proper conclusions come to regarding it before anything reliable can be decided on.

General rule for towns in Upper India.—It has already been stated that as a rule in towns in the plains of India the maximum rainfall does not exceed 12 inches in 24 hours, although for short periods rain has been often observed to fall at the rate of 1 inch per hour, but in most places, probably, it would be sufficient to provide for a rainfall of $\frac{1}{2}$ an inch an hour.

Proportion of rainfall entering drains in Upper India.—The proportion of this passing off by the drains is more difficult to arrive at, but it may be estimated generally at from 75 per cent. to 90 per cent. of the actual fall, in most towns.

The following table gives the quantity of water per acre for different rates of fall.

TABLE OF RAINFALL.

Rate of fall per hour, inches.	Total quantity per acre per hour.		Quantity per second per acre.	
	Cubic feet.	Gallons.	Cubic feet.	Gallons.
0.25	907	5,153	0.25	1.570
0.30	1,089	6,790	0.30	1.875
0.35	1,270	7,922	0.35	2.187
0.40	1,452	9,054	0.40	2.500
0.45	1,633	10,185	0.45	2.812
0.50	1,815	11,317	0.50	3.140
0.60	2,178	13,580	0.60	3.750
0.70	2,541	15,844	0.70	4.375
0.75	2,722	16,976	0.75	4.687
1.00	3,630	22,635	1.00	6.25

Sullage Water.—The amount of sullage water to be conveyed by a system of drains depends greatly on the nature of the water-supply, it will be less in towns where all water for domestic use has to be drawn from wells than in places where a regular supply by pipes exists and people can obtain it more easily; observations show that in the former case the quantity of sullage water does not exceed 2 gallons per head *per day*, but in towns where from 10 to 16 gallons of water per head of population are provided, a greater quantity is used by the inhabitants and consequently the amount of sullage is greater. The consumption of water, however, is not uniform throughout the day but at certain times the expenditure is much greater than at others; in India it is greater in the mornings and evenings than during the day, and a greater amount is generally used in the morning than in the evening when the consumption is limited to that required for drinking and cooking. Probably it would meet most cases to provide for an amount of sullage water of 1 gallon of water per head *per hour* as a maximum.

OUTFALL.

A most important point in designing a scheme of drainage for a town is the position and number of outfalls proposed; as a rule it is cheaper to have several outfalls rather than one large one as in the former case the drains are of smaller section and proper flushing is not such a costly process.

Sewage water should never be allowed to flow into the natural streams or water-courses of a district,

but it should be used for irrigation and manure of the land and if necessary, should be raised for that purpose by chain pumps or otherwise.

When rain falls in small quantities the water is almost as impure as house drainage, and it is evident therefore that such small falls of rain should be similarly diverted from the natural streams of the country. But during a heavy fall of rain the water drained is comparatively pure and may be passed into the rivers and streams without injury to them. It therefore follows that the outfall should be so designed that all sullage water and also rain when of small quantity should be led away for irrigation, but during heavy rains the contents of the drains should be taken direct to the natural streams and rivers. The arrangement by which this separation can be effected is by means of what is known as an intercepting drain, and its action will be more easily understood by a reference to the figure.

A. A² is the main drain which has a sudden drop at B.

At B. there is an opening across the main drain communicating with the intercepting drain C. C.

C. C. is the intercepting drain crossing the main drain at right angles, and on a lower level.

When there is only a small quantity of water flowing in the main drain, the velocity is low and the water takes the course shown by dotted arrows and drops through the opening at B into the intercepting drain which conducts it away to the point where it is required for irrigation.

But in the case of a flood the velocity of the water in the main drain is increased, and in place of its falling into the intercepting drain it leaps across the opening at B and passes off to the river along the drain A².

The amount of drop and the width of the opening should be adjusted so as to be suitable to the particular circumstances of each case, and the following formulæ will be found of assistance in doing so.

If w = width of opening at B.

h = depth of water flowing in the main channel at the time it is desired it should clear the opening.

h' = the height due to the velocity of water in the main channel.

F = the amount of drop required so that the water may just clear the opening.

$$F = \frac{w^2}{1.6(h+h')}$$

Or if F is given and it is required to determine the width of opening.

$$w = \{1.6 F (h+h')\}^{\frac{1}{2}}$$

The following tables give the results of these formulæ for certain cases:—

Table shewing the amount of fall necessary to enable the water to just clear the opening for intercepting drains.

Values of w .	Values of $h+h'$.							
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
0.25	0.078	...	...	...	...	...	...	...
0.50	0.310	0.150	0.105	...	...	...	...	...
0.75	0.703	0.356	0.234	0.176	0.140	...	...	...
1.00	1.250	0.625	0.416	0.312	0.250	0.208	0.178	...
1.25	1.953	0.976	0.651	0.488	0.390	0.351	0.279	...
1.50	2.813	1.406	0.937	0.703	0.562	0.468	0.402	0.351
1.75	3.825	1.912	1.275	0.956	0.765	0.637	0.546	0.478
2.00	5.000	2.500	1.666	1.250	1.000	0.833	0.714	0.625
2.50	8.125	4.062	2.708	2.031	1.625	1.354	1.160	1.015
3.00	11.250	5.625	3.750	2.812	2.250	1.875	1.607	1.406

Table shewing the limit of width of opening over intercepting drain for different falls and depths of water.

Values of F.	Values of $h+h^3$.					
	0.5	1.0	1.5	2.0	2.5	3.0
1.0	1.00	1.26	1.53	1.78	2.00	2.19
1.5	1.09	1.55	1.89	1.67	2.45	2.68
1.75	1.18	1.67	2.04	2.36	2.64	2.91
2.00	1.26	1.78	2.19	2.52	2.83	3.10
2.25	1.34	1.89	2.32	2.68	3.00	3.30
2.50	1.41	2.00	2.45	2.83	3.16	3.46
2.75	1.48	2.09	2.57	2.96	3.31	3.65
3.00	1.55	2.19	2.68	3.10	3.46	3.75
3.50	1.67	2.36	2.90	3.35	3.74	4.10
4.00	1.78	2.50	3.10	3.55	4.10	4.40

In using these tables the falls given should be slightly increased, and the widths given should be similarly somewhat decreased.

(To be continued.)

PROPOSAL FOR AN EAST COAST OF INDIA RAILWAY.

MR. H. G. TURNER, C.S., Collector of Vizagapatam, has compiled a memorandum on the subject of a railway designed to run through the Northern Circars, connecting Bezvada on the south with Khurda on the north, or more generally, a design for connecting Madras with Bengal by an East Coast Railway. The paper is drawn principally from official sources.

He says that the present time seems to be very suitable for bringing the proposal for this Railway prominently forward. For the two Railways which the Supreme Government have recently bestowed so much time and patronage upon, that is, the Bengal-Nagpur Railway and the Benares-Puri line, will both benefit most enormously by the line now proposed. The southern section of the latter line will be used by all the passengers from the Northern Circars from lower down the coast and from inside the Hyderabad frontiers. From the southern section of the Puri line they will pass over long sections of the Nagpur-Bengal line, whether they go west to Nagpur, east to Bengal, or north to Benares.

Similarly in the south there are two Railways which will almost look on this line as their foster-mother. The Bellary-Kistna line and the Hyderabad-Warangal line (tapping the Singareni coalfields) both meet at Bezvada. They discharge their goods and passengers there on the bank of a canal which is dry for several months in the year. Can there be any doubt that there must be a line from Bezvada to Coconada, the largest seaport on the East Coast?

The line now proposed will form in point of fact the connecting link between Bengal and the North-West Provinces on the north and Hyderabad and Madras on the south.

As to the local possibilities of such a line, Mr. Turner asks: What comparison can there be between it and the other lines alluded to above? He adds: Here we have an old settled tract of country about 500 miles in length, nearly every mile of which is cultivated. Rich cities are found at suitable intervals, with a sea-borne trade reckoned in millions sterling: with deltaic tracts yielding thousands of tons of food, bordered the whole way by fine uplands abounding in oil-seeds, timber and jungle products. It is hardly possible to suppress a sigh of envy at the display of lines doubled and trebled along the provinces of Bengal, the North-West and the Punjab; at the double system of lines in the Mahratta country and at the permeation of lines throughout the south and Central Madras; while the Northern Circars, the oldest, the richest, the most densely populated tract in India, remains to this day destitute of any rail communication with the outer world.

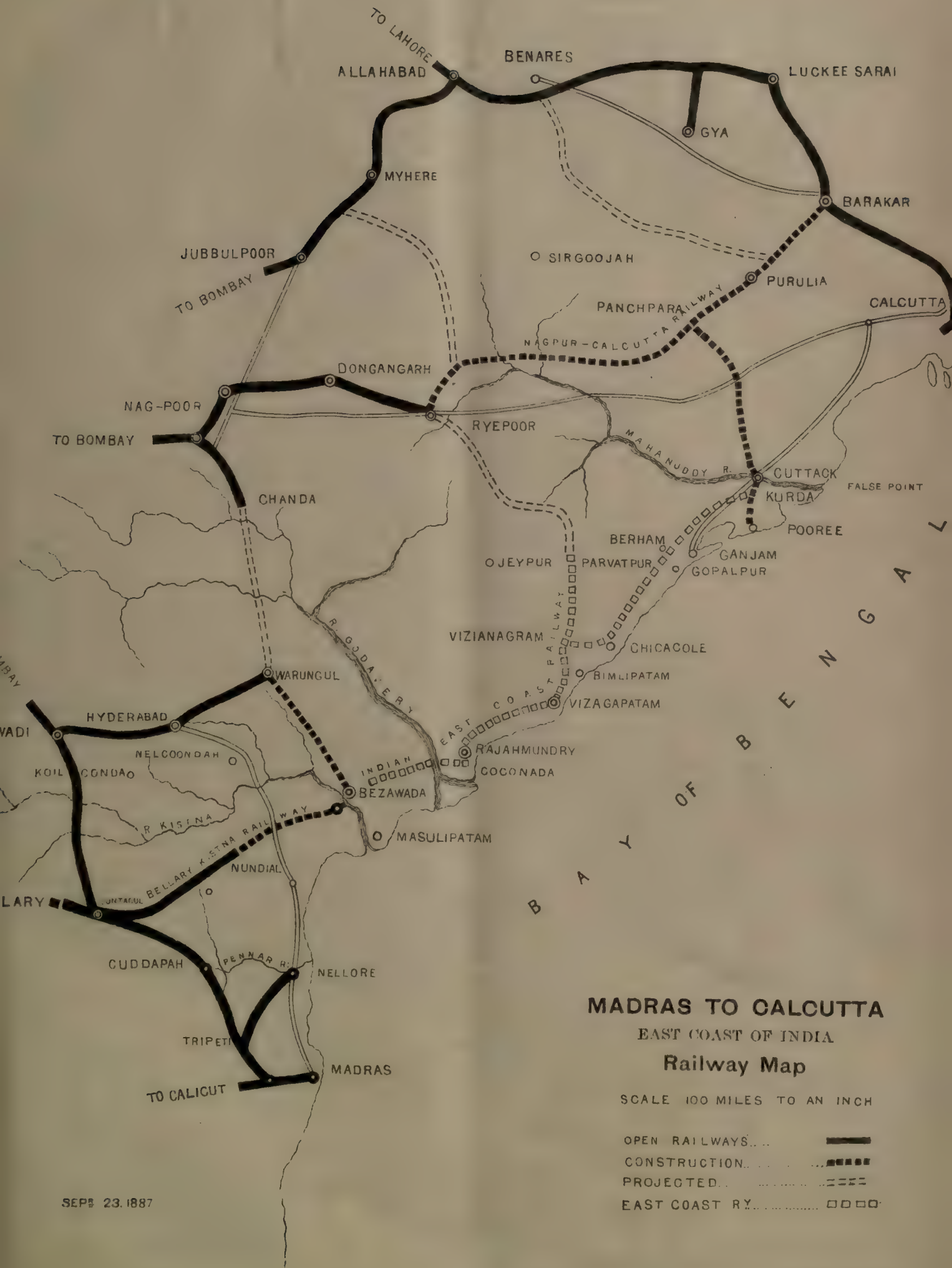
Nor are there, as will be seen, any engineering difficulties whatever all along the line; the water to be bridged is singularly little, considering that the drainage of the country appears to be crossed at right angles. There are no heavy gradients, no ghâts, morasses, or forests. The facilities for constructing the line are unexampled, the country is perfectly open and it teems with labor. All along the line of Railway are sea-ports where material can be landed and pushed up and down the track. The coast tracts are perfectly free from fever, and provisions are cheap. Roads are found everywhere. In the adjacent forests are tons of sal wood fitted for sleepers, the building stone is excellent and lime abundant.

Mr. Turner furnishes the following facts and figures in support of his proposal.

The Railway with its branches will be 600 miles in running distance (485 main line and, say, 115 branch), and it will therefore afford ample scope for the establishment of a self-contained company. It will traverse a tract of land entirely unoccupied by any Railway Company, and it will connect the railway system of the two presidencies of Bengal and Madras. There is now no connection between Madras and Bengal by rail, except along the circuitous route of Bombay and the North-Western Provinces. Even when the Nagpore-Bengal Railway is completed, the only way to get from Calcutta to Madras by rail will be to run west across the peninsula to the neighbourhood of Bombay, and then back south-east to Madras, whereas the proposed line will hug the east coast of India along the greater part of the journey.

The line now proposed is to run along the east coast of India between north latitude 17° and 20° , east longitude 80° and 86° , connecting Bengal and Orissa with Madras and the territories of His Highness the Nizam. The southern terminus of the line will be at Bezvada, latitude $16^{\circ} 30' 50''$ north, longitude $80^{\circ} 39'$ east, where the Hyderabad and Madras lines are to meet and terminate; and the northern terminus will be fixed at or near Khurda, latitude at $20^{\circ} 10' 49''$ north, longitude $85^{\circ} 40' 12''$ east, through which place the line projected from Benares to Puri is to pass on its way to the latter terminus. This line from the North-West Provinces to Puri has recently received special attention, and reference respecting it may be made to the *Gazette of India* of 20th August 1887, where a long Resolution of the Government of India, Public Works Department, is published dealing with the whole project. The southern section of the Benares-Puri line will join the Nagpur-Bengal line at Panchpara. Accordingly, the route for the Calcutta passenger to Hyderabad and Madras will be the East India line to Seetarampur, thence *via* the Nagpur-Bengal line to Panchpara; thence along the Puri line to Khurda, and thence south along the now proposed line to His Highness the Nizam's territories and to the Southern Presidency. The distances appear to be as follows:—

	Miles.
Calcutta to Seetarampur, about	130
Seetarampur to Panchpara, about	240
Panchpara to Khurda, about	190
Khurda to Bezvada, about	485
	1,045
Bezvada to Hyderabad <i>via</i> Warangal, about	220
Bezvada to Madras—	—
(a) <i>Via</i> Bellary-Kistna State Railway and Madras line, about	550
	—
(b) <i>Via</i> Nellore by road	160
Tirupati rail	80
Tirupati to Madras rail	84
	324
(c) By trunk road (Bezvada to Madras)	272



The distance from Bezvada to Khurda is about 485 miles, and the branches which will here and there be required along this course are roughly calculated at 115 miles—total opening being therefore 600 miles.

There are no engineering difficulties along the whole line. The alignment suggested passes along canal levels from Bezvada to Coconada, 120 miles, thence it follows the trunk road to Anakapalle, 80 miles. There are no heavy gradients or curves in this section. Leaving the trunk line at the latter place, it runs 20 miles to Vizagapatam. The approach to Vizagapatam will require cuttings and curves. From Vizagapatam to Vizianagram (36 miles) the line has already been surveyed, demarcated and estimated by Mr. Cregeen, in connection with the Vizagapatam-Raipore railway, now abandoned. From Vizianagram the line will run through an open level country to Chicacole, and then follow the trunk road as far as Khurda, passing through Berhampore, Ganjam and Rambha.

The Godavari cannot be bridged, at all events at present, but there will be no difficulty in crossing it by a steam ferry at Dowlaishweram. A steam ferry is provided for the Mahanadi in the estimates for the Benares-Puri line at a cost of Rs. 2,36,350. A similar ferry would be required at the Godavari.

The whole of the route along this line is densely populated. Numerous large towns lie along its course at suitable intervals.

Along the course of this line there are a quantity of shrines, 45 in number. And there is another circumstance connected with the through pilgrim traffic from the north to the south and *vice versa*, which is that almost all the shrines venerated by the Hindus lie in profusion along the eastern coast from Benares to Ramesvaram, and not along the country now tapped by the Great Indian Peninsular and Madras Railway Companies.

The Railway policy, however, of the Madras Government is guided to a large extent by considerations respecting the precautions necessary to guard districts against famine. The line now advocated is not principally a famine line. The scheme professes to take rank as a paying project. But it must not the less be lost sight of that, in point of fact, the Railway will secure the district of Ganjam from famine; and it will be remembered that within the last century there have been in Ganjam four periods of famine and scarcity. The last famine was in 1866. From January to October the district was given over to all the tribulations of famine and to the campaign against it. The Government spent over 3 lakhs of money in the combat, and 16,707 people are reported to have succumbed to the visitation out of a population of 303,779. In 1878 there was great fear of a famine. Distress was caused by high prices, and though the supply of grain did not fail, the people had no money for purchasing food.

In the report of the Famine Commission, part II., page 172, where mention is made of certain tracts at present unprovided with Railways, and at the same time difficult of access and liable to suffer from drought, a coast line of Railway in the absence of canals is recommended to connect Calcutta with Cuttack, and the deltas of the Godavari and Kistna and Madras beyond.

There are very different circumstances which environ this proposal for an East Coast Railway from those surrounding the Benares-Puri project.

That line relies for success, so far as passenger traffic is concerned, on the conveyance of pilgrims to and from Puri. There is little local traffic. There are no centres of population; no large towns adjacent to each other; no trade; no civilization. "The section of the line from Panchpara to Narajon, the Mahanadi (170 miles) passes through a country with a population of only 335,917 souls, 103 miles of which are cultivated well, fairly and partially, while the remaining mileage is mostly waste and jungle. Sambalpoore, with a population of 11,020, is the only considerable town, and with the exception of seven large villages passed *en route*, the people live "in clusters of huts of no very great number." The country is wild,

unredeemed from waste, unpopulated and at least half-a-century behind the littoral districts of the Eastern Coast. That is a line where pointsmen will have to be protected against tigers, and where wild buffaloes will scratch their backs against the telegraph posts. The Northern Circars are on the other hand fully developed and densely populated. Trade flourishes and all the aims and ends of civilization are as carefully fostered, and administration is as costly and minute as in any of the districts close around Madras or Calcutta.

As said above, it is not possible to find a stretch of country similar to this and hitherto unappropriated by any Railway Company within the Peninsula of India; and more may yet be said, for it is quite certain that there is no such opening for Railway enterprise now available in any country in the world.

Mr. Molesworth has studied, with much interest, Mr. Turner's proposal for an East Coast of India Railway, and considers the project is well worthy of more extended consideration. The enormous population and increasing traffic of the districts through which the projected line would pass indicate the desirability of introducing Railway communication into it for the further development of this important tract of country. He has already pointed out the necessity for connecting the Nizam's State Railway system and the Singareni coal-fields with the Godavari Canals, from which it will be cut off under the present arrangements for several months in the year. It is unnecessary, however, as a preliminary measure, before a detailed survey can be commenced, to undertake reconnaissance of the country between Ganjam and Coconada in order to ascertain whether any serious difficulties present themselves to the construction of such a Railway.

In connection with this project he is of opinion that a line of Railway from Cuttack *via* Balasore and Midnapore to Hooghly, so as to obtain access to Calcutta by the bridge over the river at that point, might with advantage form an integral portion of the projected system of the East Coast of India Railway. Should the Government of India consider the project worthy of further consideration, he could undertake the necessary reconnaissance of the doubtful points of the Railway in conjunction with Colonel C. J. Smith, the Consulting Engineer for Railways to the Government of Madras.

The Madras Government have urged very strongly the expediency of permitting at an early date the reconnaissance which Mr. Molesworth suggests as a necessary preliminary step to a further investigation of the project, a portion of which at least is essential for the full development of traffic on the line now under construction to Bezvada. To this the Government of India has assented provided the cost is moderate.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK XXXIII.

TEAK panel doors, with 1½" thick framing.

Items for a door of two leaves. 7' 4½" by 4' 1".	No. or Quantity.	Rate.	Amount.	Total.
(1)	(2)	(3)	(4)	(5)
Labor.—				
Carpenters No. ...	10			
Coolies " ...	2½			
Carts " ...	4			
Sundries				
Materials.—				
Teak wood, including waste c. ft. ...	5-18			
Butt hinges 6" No ...	6			
Door bolts 18" " ...	1			
Do. 12" " ...	1			
Screws 2" doz. ...	4½			
" 1½" " ...	1½			
Holdfast hooks No ...	1			
Wooden hook-blocks ...	1			
Sundries				
Petty Establishment				
Total for 30'6 Sqr. ft.				

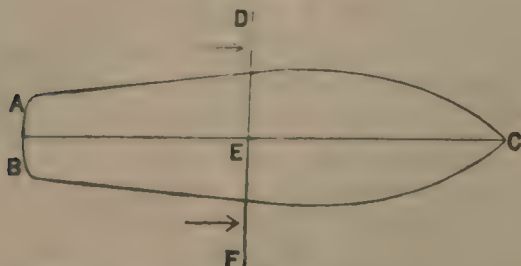
PROPERTIES OF FLUIDS.

BY A. EWBANK.

XIV.

WIND acts on the whole of the unimmersed portion of a ship, that is on the hull, masts, rigging and sails. But as we are discussing principles and not details, and as the chief action is exerted on the sails, we confine our attention to them.

Fig. 44.



The simplest case is presented by *fig. 44*, in which the wind (acting horizontally) and the ship move in the same direction. Here *D'F* denotes a sail, and if we consider the sail as approximately a plane surface, we have its plane perpendicular to the plane of the paper. In this case the sail is said to be set square or across the ship or athwart-ships. Here the wind direction, the wind effective force and the line of movement are all coincident.

Fig. 45.

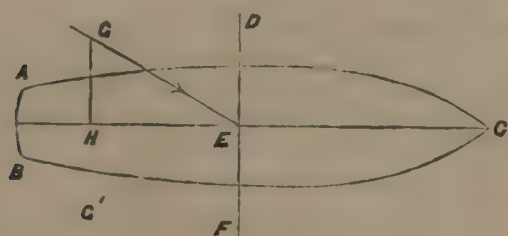
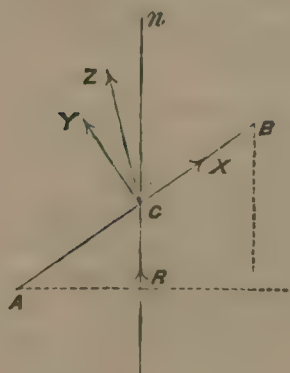
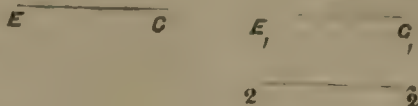


Fig. 41.



In *fig. 45* the sails are still athwart-ships, but the wind strikes them obliquely. Let *G'E* denote the wind direction. Then, as with *fig. 41*, we replace the real wind by a component wind *G'H* and a component wind *H'E*. The *G'H* wind striking the sail edgewise is of small account as far as concerns its action on the hull above water. But we are confining our attention to the sail. The effective wind force is *H'E*, if we neglect the small action that *G'H* may have on the sail. Suppose that in the figure the lines *G'E*, *H'E*, *G'H* are as 5, 4, 3. Then by the wind *G'E* we mean a wind which would exert a force 5 on the ship. By the component wind *H'E*, we mean a wind that would exert a force 4 on the same ship. Thus the sail *D'F* receives a certain force which we call 4. If the sail *D'F* were turned round so as to face directly—or have its plane normal to—the wind *G'E*, it would then receive a force which must be called 5.

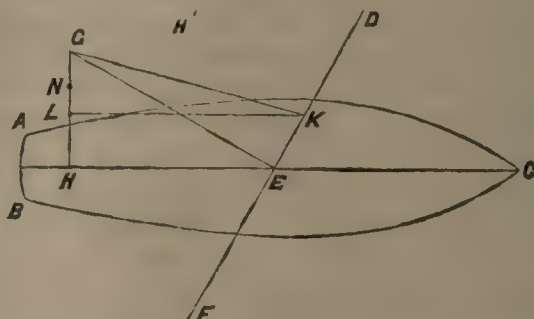
Fig. 46.



Under the action of the wind *H'E* the ship moves in the direction *E'C*. It drifts sideways however in consequence of the component wind *G'H*, which acts on the whole length of the ship's side. Thus the real motion of the ship is indicated in *fig. (46)*, where, *E'C* denoting the ship, moves to *E₁C₁* by virtue of the wind force *H'E*, and drifts sideways to *E₂C₂* by reason of the wind *G'H*. This sideways drift is called leeway or "making leeway." In *fig. 45* the wind which acts obliquely, is said to be on the quarter. Here the wind is on the left or "port" quarter.

We might have the wind blowing in the direction *G'E*, *fig. 45*. Then it would be on the right or the "star-board" quarter. The ship will (neglecting leeway) travel along the same line as before, its sails keeping the position of *fig. 45*. The ship would however in reality make leeway on the other side, *viz.*, on the port side. If we neglect leeway, we see that approximately two different winds *G'E*, *G'E* may drive a ship in the same direction. Here the leeway is chiefly due to the action of the wind on the hull. Though we are not professedly taking this action into consideration, yet in this particular case we notice it as the action is so obvious.

Fig. 47.



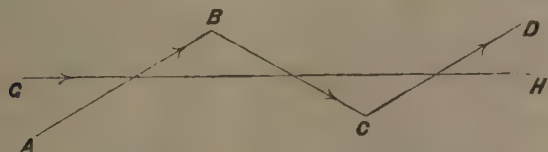
In *fig. 45* we had the wind blowing in one direction *G'E*, and the effective wind force on the ship, *i.e.*, on the sail acting in another direction *H'E*. Then neglecting leeway, the wind force and the ship's motion coincide in direction. But generally, as above stated, the wind itself, its effective wind force and the ship's movement are in three different directions. Then in *fig. 47* *G'E* is the wind direction. *G'E* also would measure the total effective wind force were the plane of the sail at right angles to *G'E*. The sail is not at right angles to *G'E*. It has been turned through a certain angle, so that the component winds are no longer *G'H* and *H'E*. *G'K* is perpendicular to the sail and the component winds are now *G'K* and *E'K*, of which the latter, as before, will be neglected. The effective wind force on the sail, and therefore on the ship, is now *G'K*. In the figure the sail has been so placed that *G'K* is greater than *H'E*. In other words, the sail has been so set or trimmed as to experience more wind force than it did when it was set square as in *fig. 45*. The ship however will not move in the direction *G'K*. We must resolve *G'K* into two forces *G'L* and *L'K*. Then *G'L* drives the ship sideways—or broadway on—while *L'K* drives the ship lengthways, which latter is the direction in which the water will most readily yield it a passage. The consequence is that the real direction of motion as resulting from the wind force *G'K* is some direction like *N'K*, where *N* is a point between *G* and *L*. This matter has already been discussed—see *fig. 41* and the text corresponding. Finally therefore the wind blows in some direction *G'E*, and the ship moves approximately in some direction *N'E*.

Fig. 48.



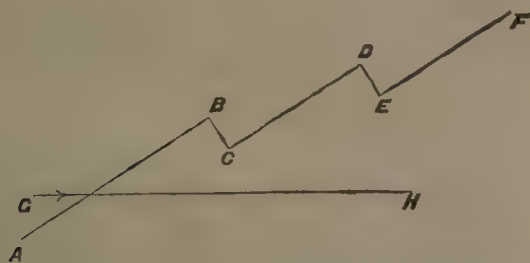
If a ship can travel in a line N E by means of a wind G E, *fig. 48*, it follows that it could also travel in a different line M E by means of the same wind G E. Here the angle M E G must equal the angle N E G. In order to change the ship's course from N E to M E, we must by hand alter the set of the sails, and by the rudder, the position of the ship. In *fig. 47* G E D is an acute angle and G E F obtuse. We must in the new case have G E D obtuse and G E F acute. In the new case the wind G E will be on the right or starboard quarter. The new position of E H will be the line E H'. The old and new positions of the hull and sails will be symmetrically arranged with reference to the line G E.

Fig. 49.



We may change from one of these courses to the other repeatedly. We shall then have the ship moving in a manner indicated by *fig. 49*. Here the wind direction is G H. The ship moves successively along the lines A B, B C, C D, &c. This zig-zag process is called tacking.

Fig. 50.



In *fig. 49* the lengths A B, B C, C D are drawn equal. In *fig. 50* they are alternately long and short. By varying the lengths A B, B C we have it in our power while always starting from one place A to arrive at various places, by skilfully making use of one unchanging wind.

NOTES FROM HOME.

(From our own Correspondent.)

THE Directors of the Hull and Barnsley Railway Company have rejected the proposals of the Midland Railway Company as to a proposed working agreement between the two Companies. The Midland Company practically proposes to work the Hull and Barnsley Railway at 58 per cent. of the gross receipts during the first two years, and at 56 per cent. during the third year of the agreement, and at 55 per cent. in perpetuity thereafter. To these terms the Hull Corporation are very strenuously opposed.

Mr. John Aird, M.P., on Saturday last, presented to the successful students of the Crystal Palace Company's School of Practical Engineering the certificates gained during the term just closed. He reviewed in very favorable terms the work carried on in the several offices and shops of the school, adverted to the excellent results that were obtained from the work of the school, and expressed, as a large contractor, his satisfaction with the specification the students had prepared, and adjured them to work earnestly and steadily. The report was read by the Superintendent of the School, and Mr. Wilson, the Principal of the School, made some remarks to the students.

Mr. Light, who has for nearly three years very ably conducted the affairs of the Society of Engineers as Secretary, has been obliged, through failing health, to resign his post. Mr. Cuxon, for many years the Secretary of the Civil and Mechanical Engineers' Society, has been appointed to succeed him.

The prospectus has just been issued of the St. James' and Pall Mall Electric Light Company, a company formed to

establish a central station for the electric lighting of the area of which St. James' Square may be described as a centre, and which includes Pall Mall, St. James' Street, Piccadilly and Waterloo Place. This area contains, within a radius of 450 yards from the central station, most of the London clubs, many public buildings and fashionable places of business, and is therefore considered to offer an unrivalled field for the operations of the Company. The charge of the lamps will be made either by contract at a certain sum per lamp per annum or by meters, and it is calculated that from a first installation of 10,000 lights a dividend of 12 per cent. will be paid on the ordinary capital of the Company.

The paper read at the last meeting of the Institution of Civil Engineers was "The Distribution of Hydraulic Power in London" by Mr. E. B. Ellington, in which it was stated that the delivery of power-water from the principal pumping station is through five 6-inch mains. The most distant point from the accumulators is just over 5 miles. To provide for frictional loss in the pipes and valves, the accumulators have been loaded to 750 lbs. per square inch, while the pressure supplied is 700 lbs. The method employed for detecting leakage is based upon an automatic record of the number of gallons delivered into the mains. At the end of last year there were about 600 machines of various kinds working from the mains.

At the Royal Institution of British Architects, Mr. V. B. Lewes recently gave a lecture on Illumination and Ventilation. This lecture included tables giving the analysis of the air in rooms when candles, oil and gas are used. Experiments were also described that were made on ventilation burners.

A work, which has been watched with great interest by engineers and geologists for some time past, has just been brought to a successful termination by the completion of an artesian well 1,106 feet deep at King's Heath, near Birmingham. In this boring 547 feet of marl and gypsum were penetrated. The work of boring is done by Messrs. LeGrand and Sutcliffe of London.

It is again reported that the Metropolitan Railway are about to take steps to work their line by electricity, and it is stated that if the project be carried out, the working expenses will be at a much lower figure than they at present figure at. Such a satisfactory prospect is said to be the cause for the recent rise in the quoted price of the shares in this Company.

According to the *Newcastle Daily Chronicle* recent trials of the compound locomotive of the Worshell type on the North-Eastern Railway are such as to confirm the statements previously made as to the saving of fuel. A series of runnings this year under similar circumstances shews that the compound engine has used about 28 lbs. of coal to 35 lbs. used by the ordinary locomotive.

According to a paper recently read before the Liverpool Engineering Society on Boiler Explosions it appears that the average number of steam boiler explosions during the last 25 years was about 56 per annum, the average loss of life amounting to about 70 per annum. The actual percentage of explosions to boilers at work was very small, being at the rate of one explosion to every 2,500 boilers at work. And owing to the improvements in the design and construction of boilers the percentage had been further reduced to one in 6,000.

Another explosive has come into the field, called carbo-dynamite, a description of which is to be found in the last issue of *Engineering*. This substance claims advantages over nitro-glycerine, which forms the explosive agent in the many explosives invented of late years. Comparative experiments have lately been made in the Rhonda Valley with this substance and with dynamite. Very interesting results are recorded. The price of the new explosive is not more than dynamite, whilst its force is greater.

A correspondent of *Scientific American* reports the opening of a section of the Panama Canal, and states that by the end of this month the canal will be navigable for fifteen miles. The excavations are stated to be proceeding rapidly. It may be here noted that the Committee of the French Chambers has reported in favor of the Panama loan.

Barnard's Inn, between Holborn Circus and Fetter Lane, one of the few genuine pieces of antiquity in that part of the metropolis and the last survivor of the old Inns of Court, now disused, is destined to fall under the auctioneers' hammer.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Mysore, May 12, 1888.

Mr. T. Inman, Executive Engineer, Bangalore Division, is granted privilege leave for three months, with effect from the 1st June 1888, or date of departure.

Burma, May 12, 1888.

Upper Burma

With reference to *Gazette of India* Notification, dated the 14th February 1888, Mr. B. Baxter, Executive Engineer, 2nd grade, sub. *pro tem*, reported his arrival at Mandalay on the forenoon of the 23rd April 1888, and is temporarily posted to the charge of the Mandalay Garrison Division, with effect from the afternoon of the 1st instant, *vice* Mr. A. desA. deCrettes, Executive Engineer, 2nd grade, re-transferred to the charge of the Henzada Division, Lower Burma.

With reference to *Burma Gazette* Upper Burma Notification dated the 4th May 1888, Mr. B. Baxter, Executive Engineer, 2nd grade, sub. *pro tem*, was temporarily attached to the Mandalay Garrison Division from the forenoon of the 23rd April 1888 to the forenoon of the 1st instant.

Lower Burma.

Mr. M. Birkbeck, Executive Engineer, 2nd grade, reported his return on the afternoon of the 10th May 1888 from the one year's leave on medical certificate granted him in Burma Public Works Department Notification, dated the 12th April 1887.

Mr. Birkbeck's services are placed at the disposal of the Special Superintending Engineer, Upper Burma.

Madras, May 15, 1888.

The following transfers are ordered at the public expense:—

Mr. A. Joyce, Executive Engineer, 3rd grade, from the V. Circle, Public Works Stores and Workshops, to the Charge of No. I. Party, Tank Restoration Scheme, Madura. To join on expiration of privilege leave.

Mr. J. M. Bell, Executive Engineer, 2nd grade, from No. I. Party, Tank Restoration Scheme, to the charge of No. II. Party, Chingleput. To join on relief by Mr. A. Joyce.

The following posting is ordered:—

Lieutenant-Colonel S. C. Clarke, R.E., Executive Engineer, 1st grade, to the V. Circle, for charge of the Public Work Stores and Workshops. To join on return from leave.

Bombay, May 17, 1888.

Railway.

With reference to the Notification by the Government of India, dated 4th May 1888, His Excellency the Governor in Council is pleased to appoint Major R. A. Sargeant, R.E., to officiate as Joint Secretary to Government in the Public Works Department (Railway), during the absence of Major F. Firebrace, R.E., or until further orders.

Punjab, May 17, 1888.

Mr. A. Grant, Executive Engineer, 4th grade, temporary rank, attached to the Kohat Provincial Division, was allowed special leave from the 25th December 1886 to the 15th January 1887, both days inclusive. This cancels Public Works Department Notification dated 17th March 1887.

Irrigation Branch.

Mr. R. B. Yates, Assistant Engineer, 1st grade, from the Chiniot Canal Survey Party, which he left on the afternoon of the 14th April 1888, to the Chenab Canal Division, which he joined on the forenoon of the 15th idem.

N.-W.-P. and Oudh, May 19, 1888.

Irrigation Branch.

Mr. A. C. Polwhele, Assistant Engineer, 1st grade, sub. *pro tem*, is granted two months' leave, with effect from the last May 1888, in order to study the Native language.

Buildings and Roads Branch.

In anticipation of the approval of the Government of India, Mr. J. W. Alexander, Executive Engineer, 1st grade, and Superintendent of Works, 2nd Circle, Provincial Works, is appointed Officiating Superintending Engineer, 3rd grade, of that Circle, *vice* Colonel E. Swetenham, R.E., proceeding on furlough.

Major R. R. Pulford, R.E. (Executive Engineer, 1st grade), Personal Assistant to the Chief Engineer, Public Works Department, North-Western Provinces and Oudh, Buildings and Roads Branch, and Assistant Secretary to Government in the Railway Branch, is appointed to officiate as Superintendent of Works, 3rd Circle, Provincial Works, *vice* Mr. Alexander, in addition to his duties as Assistant Secretary, Railway Branch.

Mr. J. H. P. Forsyth, Executive Engineer, 4th grade (District Engineer, Moradabad) is transferred to the Public Works Secretariat and appointed Officiating Personal Assistant to the Chief Engineer, Buildings and Roads Branch, *vice* Major Pulford, R.E.

Assam, May 19, 1888.

Mr. E. J. Mitchell, Assistant Engineer, 1st grade, is transferred from the Naga Hills Division to the Kamrup district, and appointed to officiate until further orders as District Engineer of the latter district.

India, May 19, 1888.

With the concurrence of the Secretary of State for India, His Excellency the Governor-General in Council is pleased to admit the undermentioned Engineers with European training appointed

to the Public Works Department in India to the benefits of the more favorable pension rules for Civil Engineers published in Resolution of the Government of India in the Finance Department, No. 449, dated the 18th April 1884:—

Mr. J. Adams.

" W. Algie.

" J. A. Anderson.

" G. A. D. Anley.

" A. H. Barron.

" B. W. Blood.

" R. C. Beeston.

" A. Brereton.

" C. H. Brereton.

" J. W. Buyers.

" B. W. Cantopher.

" M. J. Chabrel.

" H. N. C. Clöete.

" J. Conder.

" R. A. Cordner.

" W. G. L. Cotton.

" P. W. Dangerfield.

" J. Y. Davidson.

" J. D. Davies.

" J. I. R. Dempster.

" F. L. Dibblee.

" P. Duncan.

" G. W. Faulkner.

" W. C. L. Floyd.

" H. H. Gahan.

" W. E. Garstin.

" A. S. Gerrard.

" E. L. Gramatzki.

" T. W. Grant.

" F. N. Gütersloh.

" E. H. Hallum.

" J. H. E. Hart.

" A. Hayes.

" C. W. E. Henslowe.

" F. B. Henslowe.

" R. N. Hodges.

" E. W. M. Hughes.

Mr. E. L. Hunt.

" H. Irwin.

" H. Johnson.

" J. J. Jones.

" W. R. S. Jones.

" J. C. G. Keddie.

" T. Ker.

" A. S. Knolles.

" E. E. A. Küster.

" G. J. R. Leeson.

" J. E. P. Lincké.

" G. H. List.

" G. V. Martyn.

" F. B. MacLaran.

" E. J. G. McCudden.

" F. J. McLaughlin.

" M. C. McKinnon.

" W. E. Meares.

" G. E. Moore.

" F. H. W. Morse.

" D. Morris.

" A. J. Oldham.

" W. C. Rennie.

" L. R. Roberts.

" J. M. Salmond.

" F. Sills.

" W. K. Stent.

" G. E. Thomas.

" J. H. Thornhill.

" T. M. L. Thompson.

" J. H. Toogood.

" G. T. Walch.

" F. B. Walker.

" B. G. Wallis.

" H. W. Warden.

" W. H. White.

" T. H. Wickes.

Mr. J. W. Alexander, Executive Engineer, 1st grade, North-Western Provinces and Oudh, is appointed to officiate as a Superintending Engineer, during the absence of Colonel E. Swetenham, on furlough, or until further orders. While so officiating Mr. Alexander will hold temporary rank in the 3rd class.

Mr. A. Scott, Honorary Assistant Engineer, Central Provinces, temporarily employed in the Simla Imperial Circle, is retransferred to those Provinces, with effect from the date of the expiry of the privilege leave for three months which has been granted to him from the 1st April 1888.

Major W. H. Coaker, R.E., Officiating Deputy Consulting Engineer to the Government of India for Railways, Calcutta, reverted to his substantive appointment of Deputy Consulting Engineer for Railways, Madras, with effect from the afternoon of 14th April 1888.

Mr. W. B. Taylor Executive Engineer, 1st grade, State Railways, is granted special leave for one year and seven months under the terms of Public Works Department Resolution, dated the 3rd October 1887.

Lieutenant W. S. Hunter, R.E., Assistant Engineer, 2nd grade temporary rank, Military Works Department, is temporarily attached to the Public Works Department, Burma, Provincial Branch, for special duty on defence works at Rangoon.

With reference to Bombay Government Resolution, dated 10th November 1887, Lieutenant M. Nathan, R.E., Assistant Engineer, 1st Grade, supernumerary, Bombay Establishment, is transferred to British Burma Provincial Branch, as a supernumerary, but will continue at the disposal of the Inspector-General, Military Works, with the rank of Executive Engineer, 4th grade, as already notified in Military Works Department Notification dated the 27th January 1888.

Military Works Department.

Lieutenant W. J. D. Dundee, R.E., is appointed to the Military Works Department as an Assistant Engineer, 1st grade, with effect from the 30th March 1888.

Director-General of Railways.

With reference to Public Works Department Notification, dated 2nd May, 1888, the undermentioned Apprentice Engineers are posted to the Railways specified opposite their names:—

Mr. H. W. Perry—North-Western Railway.

Mr. J. Eaglesome—Sind-Pishin State Railway.

North-Western Railway.

Mr. F. Reilly, Executive Engineer, 4th grade, attached to the Chenab Bridge Works, North-Western Railway, is granted furlough to Europe for eighteen months with the usual subsidiary leave, with effect from the 18th May 1888, or such subsequent date as he may avail himself of it.

Bengal, May 23, 1888.

Establishment—General.

Mr. W. A. E. Hanby, Assistant Engineer, 3rd grade, having passed the professional examination on the 16th instant, is promoted to the 2nd grade, with effect from that date.

Advertisements.

COMMISSARIAT NOTICE. FOR SALE.

A PORTABLE 12 Horse-power STEAM ENGINE, Multitubular, containing:—

Boiler, complete.
Cylinders do. with fittings.
Pistons do. do.
Piston Rods do.
Fly Wheel, &c.

Apply to—

The CHIEF COMMISSARIAT OFFICER,
Lahore Division,
Meean Meer, who is open to offers.

East Indian Railway.

Sale of surplus and condemned stores comprising anchor heaver boat and other boats, old section iron fishplates, plate glass, incomplete rail-presses and carriage turntable, scrap cast and wrought iron, scrap steel and brass, copper ingot, mixed metal borings and sweepings, old iron and steel rails and crossings, old wrought iron wheel centres with steel tyres, wrought iron skeleton wheels, steel scrap springs and tyres, firewood sleepers, miscellaneous firewood, &c., &c., &c.

Tenders will be received at the office of the Controller of Stores, East India Railway Company, Fairlie Place, Calcutta, up to noon of Thursday, the 14th June 1888, for the purchase of surplus and condemned stores as above at Howrah, Giridih, Asansol, Jamálpur, Dinapore, Cawnpore, Gháziabad and Delhi.

Tenders must be submitted in the form to be obtained at the office of the Controller of Stores, where printed lists of the stores can also be had, and tenders submitted in any other way will not be considered.

The various lots are open to inspection by intending purchasers on application to the Storekeepers in charge of the depôts where the stores are respectively located.

D. W. CAMPBELL,

AGENT.
(126)

CALCUTTA, 18th May 1888.

SINGARENI COAL MINES. WANTED.

Coal Mining Contractors having good control of labor. Cash will be advanced to reliable parties to assist in bringing miners.

Pit Carpenters, Fitters and Blacksmiths also required. Good men will be well paid.

Apply or address—

MINING ENGINEER,
Hyderabad (Deccan) Company,
SECUNDERABAD.

(120)

EMPLOYMENT WANTED.

By an experienced Mechanical Draughtsman, accustomed to Estimate and Design. Good References.

Address—

C. N. J.,
c/o EDITOR
Of this Journal.

HOWRAH MUNICIPALITY.

For Sale, Steam Fire Engine.

SEALED TENDERS for the purchase of a Steam Fire Engine, made by Messrs. Merryweather and Sons, specification of which can be seen at the office of the Commissioners, on week days from 11 A.M. to 5 P.M. will be received by the undersigned up to 31st May 1888.

This Engine has never been used and is in excellent condition and in good working order.

The Commissioners do not bind themselves to accept, the highest or any tender.

(125)

G. C. ROY CHOWDRY,
Vice-Chairman.

BEST MIRZAPUR STONE.

The Mirzapur Stone and Trading Co., Cut-Stone Contractors and Quarrymen Mirzapur, can supply—

Flagging Roofing.
Pillar Bases Coping.

And all descriptions of Cut-Stone. The cheapest in the market.
Apply to the Company or to

LYALL, MARSHALL & CO.,

4, Olive Ghat Street, CALCUTTA.

(109)

Depôt—Sulkea, Calcutta.

A GREAT WANT SUPPLIED.

No Package Genuine
without this Trade
Mark.



No Package Genuine
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Mark.

Registered 14th October 1878.

CYLINDER OIL.

TURNER, MORRISON & Co., Calcutta,

(93)

Sole Agents for Bengal.

Calcutta Plumbing & Gas Fitting Establishment.



Materials of all sorts for the above always in stock. Trade supplied on the usual terms.

J. D. JONES,
Mechanical Engineer,
PROPRIETOR.

(108)

MADRAS PRESIDENCY DIAMOND FIELDS, LIMITED,

SITUATE AT

WADJRA KARUR (VILLAGE OF DIAMONDS)

NEAR BELLARY, MADRAS.

INCORPORATED UNDER THE LIMITED LIABILITY ACTS, 1862 to 1883.

CAPITAL, £190,000, IN 38,000 SHARES OF £5 EACH.

OF WHICH 18,000 SHARES ARE NOW OFFERED FOR SUBSCRIPTION.

(2,000 BEING RESERVED FOR INDIA, AT RS. 75, THIRTY RUPEES PER SHARE PAYABLE ON APPLICATION.)

Payable 10s. per Share on Application.

Payable £1 10s. per Share on Allotment.

Further Calls will be made as required. No Call to exceed £1 per Share, or be made at intervals of less than one month.

Shareholders desiring to pay up in full, on allotment, can do so. Interest at Six per cent. per annum will be allowed on such pre-payment.

DIRECTORS:

ROBERT E. NORTH, Esq. (Messrs. R. E. NORTH & Co.),
57-D, Hatton Garden, E.C. (Managing Director of the
Diamond-Cutting Company).

W. CARLTON WOOD, Esq., 41, Basinghall Street, E.C.

EDMOND POWER, Esq. (Messrs REMINGTON & Co.),
Henrietta Street, Covent Garden, W.

BENJAMIN W. FORD, Esq., 38, Leadenhall Street, E.C.

*CHARLES H. STRUTT, Esq., 5, Harrington Gardens,
S.W.

*ROBERT GORDON ORR, Esq. (Messrs. P. ORR &
Sons), Madras, Resident Director. (Chairman of the
Commercial Land-Mortgage Bank of Madras, Limited.)

* Will join the Board after Allotment.

Commercial Agents in India.—MESSRS. P. ORR & SONS, Madras, Diamond Merchants, Jewellers, and Goldsmiths.

Resident Engineer in India.—MR. ROWLAND BATEMAN SMYTH (Late of the Geological Survey of India.)

Bankers.—MESSRS. HENRY S. KING & CO., 65, Cornhill,
E.C.

Brokers.—MESSRS. LANE BROTHERS, 22, Threadneedle
Street, E.C., and Stock Exchange.

Solicitors.—MESSRS. SLADE & MUNK, St. Clement's House, Clement's Lane, E.C.

Auditors.—MESSRS. JOHN F. LOVERING & CO., Chartered Accountants, 77, Gresham Street, E.C.

Secretary.—MR. A. W. BROWNING.

Offices.—Winchester House, Old Broad Street, E.C.

This Company has been formed to acquire 250 acres or thereabouts of Freehold Land with the Perpetual Mining Rights, situated at Wadjra Karur, in the district of Annantapur, in the Presidency of Madras; and also the Perpetual Mining Rights of 304 acres or thereabouts situated in the same district, making in all 554 acres.

Wadjra Karur, which is within nine miles of Gundakul Junction, Madras Railway, is the native Indian term for "Village of Diamonds;" it has for years been known, as its name indicates, as a district where diamonds have been found. These, however, have not been the result of scientific working by machinery, the natives contenting themselves with scraping the surface during the rainy season, or soon after, when the diamonds thus discovered are sold to native princes or dealers in Madras and elsewhere.

Some time since a very large diamond was found at Wadjra Karur,

weighing 67½ carats, and was offered to Messrs. P. Orr & Sons, of Madras, the well-known diamond merchants and jewellers, who, struck with its appearance and size, after consultation with Mr. John Brukowsky, the experienced diamond expert of London and Zurich, purchased it, and having made enquiries, they decided to jointly purchase the lands and mining rights at Wadjra Karur herein referred to. Accordingly, negotiations were set on foot, and some idea may be formed of the labour involved in this when it is stated that there are 44 deeds of conveyance from nearly as many native owners. The legal titles have been examined by the eminent firms of solicitors, Messrs. Barclay and Morgan, and Messrs. Wilson and King, of Madras.

The circumstances under which Mr. John Brukowsky advised and joined in the purchase of the Diamond Fields is best told in the following statement made by that gentleman:—

MADRAS PRESIDENCY DIAMOND FIELDS, LIMITED.—(Continued.)

41, BASINGHALL STREET, E.C.,
LONDON, 9th March 1888.

Some years ago, hearing of the discoveries of diamonds in South Africa, and having been connected with the precious stone trade for the last twenty years, I proceeded to inspect the Diamond Fields in Kimberley and at Jagersfontein. Shortly after this, when at Ceylon, I received a letter from Mr. R. G. Orr, of the eminent Firm of Messrs. P. Orr and Sons, Madras, informing me that a remarkable diamond had been discovered, and requesting me, as a special judge of these stones, to come immediately to Madras and inspect the stone. I then went to Madras, and as soon as I saw the stone I said, "Don't let it go for any amount," and the seller received what he asked for the gem. I at once enquired where this wonderful stone came from, and the seller informed me that it came from Wadjra Karur, and this was confirmed by several natives through whose hands the stone had passed.

The gem above referred to, now known as the Gor-do-Norr Diamond, was sent to Gebrüder Hony and Co., of Hanau, Germany, the diamond cutters, where it was cut and polished, and weighs $24\frac{7}{8}$ carats, and for purity of lustre and brilliancy is said to be unsurpassed by any stone in existence.

I then proceeded to Wadjra Karur, and, to my great astonishment, found the geological appearance similar to the African which I had so recently left.

The hillocks are thrown up evidently by volcanic action; the gravel, the floating reef, and some blue clay (thrown up where wells had been sunk) all proved conclusively to my mind that I was in the presence of probably one of the greatest diamond mines in the world.

I stayed in the neighbourhood for some two months, and the natives from the village brought me rough diamonds, which I bought; and very fine ones these were. Some of these diamonds I sold through Mr. R. E. North, of Hatton Garden, London, and they all realised very high prices, the Indian stones being, on account of their lustre, worth considerably more than the Cape stones.

Mr. Orr, of Madras, had continually been buying stones from Wadjra Karur, and is doing so at the present time. One weighing $18\frac{1}{2}$ carats in the rough, from this field, cut down to $6\frac{1}{2}$ carats, was ultimately sold, through Mr. W. Carlton Wood, for £675, being £105 per carat, to Messrs. Tiffinay, of Paris and New York. Last year I bought some stones from this village, and as an indication of the class and quality of the gems, I may mention that I sold one weighing about $6\frac{1}{2}$ grains to Messrs. Biedermann, of Vienna, for 700 florins.

I may add that, having satisfied myself that the property was diamondiferous ground, I consulted with Mr. Orr, and his firm and myself jointly acquired 554 acres freehold land, or mining rights at Wadjra Karur.

The configuration of the place indicates the basin formation, as well as the pipe, so well-known to South African miners, and if it is opened up according to modern scientific diamond mining, I have the most profound conviction that the results will equal those of Bultfontein and Jagersfontein in quantity, while in quality, stones of infinitely superior lustre and value may be expected.

(Signed) J. BRUKOWSKY.

The above diamond is referred to by Professor Church, M.A., F.C.S., F.I.C., in his South Kensington Museum Art Hand-book, entitled "Precious Stones." He says, the "Gor-do-Norr" has a specific gravity of 3.527; and Mr. R. B. Foote, F.G.S., Superintendent, Geological Survey of India, referring to this diamond, in his Notes on the Geology of parts of Bellary District, says: "Mr. R. G. Orr has now a Wadjra Karur diamond for sale, valued at more than £10,000. It is a large and remarkably fine stone."

The Company has the option of purchasing the Gor-do-Norr diamond on advantageous terms, and offers it for sale at the price of £15,000, which, though leaving the Company a handsome profit, the Directors are assured by competent experts in precious stones is a very moderate price to a purchaser.

The Wadjra Karur properties have been inspected, by request and instruction of Messrs R. G. Orr and J. Brukowski, by Mr. Andrew Copley, and Mr. R. Bateman Smyth, Mining Engineer, whose Reports are enclosed herewith, and to which special attention is directed.

MR. ANDREW COPLEY SAYS:—"The natives of India, past and present, have shown no disposition to engage in deep mining. It may be that this is why they have not hitherto developed this most remarkable formation. Some of the oldest Cape diamond miners may still recollect that the famous Colesberg Kopje—by which name the Kimberley Mine was known in 1870—was rushed and abandoned six times before people realised that they had been coquetting with what is now one of the richest known diamond mines.

"Taking at this time a retrospective view of the whole, I see no reason to doubt (water being abundant and labour cheap) that with proper machinery this property will develop into a valuable diamond-mining industry."

MR. R. BATEMAN SMYTH SAYS:—"The land having been secured without any liability for royalty, and I having tested and conclusively proved the extent and quality, nothing more remains but to open out the Mine in accordance with modern scientific methods. When a shaft has been sunk right down into the blue clay pipe, and the property fairly developed, the result will, in my opinion, be as abundant and satisfactory as the diamond mines of Kimberley and Griqualand West."

It will be observed from the enclosed Report of Mr. R. Bateman

Smyth that the basin or pan at Wadjra Karur covers between 60 and 70 acres, whilst the extent of the Kimberley Mine consists of but a few acres.

So soon as this Company has got its machinery at work, and has proved to the world the value of the Wadjra Karur property, which the Directors are advised will be in about six months, it is the intention to mark it out in blocks, as at Kimberley, and in addition to working, will either form subsidiary companies, or sell or lease portions from time to time on the plan pursued by the South African Exploration Company, whose shares, 10s paid, now stand at £18 per share.

As to the principal Diamond Companies at work, the profits from holding their shares will be seen by the following table of premiums at which they stand, and the Directors believe there is every reason for the shares of this Company, as a parent Company, rising to a high premium.

Name of Company.	Paid-up Capital.	Paid up per Share.	Present Price.
De Beer's...	£2,510,000	£10	£42
Kimberley Central ...	1,422,950	10	41
New Jagersfontein ...	129,000	10	21
Bultfontein ...	140,000	5	22
United Diamond ...	.....	1	3½
Klepfontein ...	.....	1	3

The De Beer's Company have just declared a quarterly dividend at the rate of 40 per cent. per annum and the Kimberley Central Company at the rate of 36 per cent. per annum.

India is known as the natural home of the diamond. The Diamond Fields of India have been celebrated from remote antiquity; and, with the exception of Brazil, until the South African discoveries, most of the diamonds in the world came from there, and this without any scientific working on modern principles. The clear blue-white water of the Indian stones has never been equalled either in size or quality, by the output of any other country.

Most of the historical and renowned diamonds have been found in India, and, amongst others, the following:—

Name of Stone.	Weight in the Rough.	Weight when Cut.
The Nizam ...	340 carats	.....
The Great Mogul ...	787½ "	279½ carats
The Great Table ...	.....	242½ "
The Regent ...	410 "	136½ "
The Austrian Yellow ...	.....	139½ "
The Koh-i noor (the Property of Her Majesty) ...	193 "	102½ "

and now from the Wadjra Karur Fields, before they are opened out, another is given to the world, viz., the Gor-do-Norr, surpassed in quality, brilliancy and purity by none of the above, but superior to most of them.

The amount to be paid for the Freehold Land and Mining rights is £1,60,000, payable in shares of the Company to be issued as fully paid up. This will leave ample working capital.

The Directors do not think it necessary to add to the above statements, except to draw the attention of intending investors to the small amount of the Company's capital as compared with the existing diamond companies, and to the enormous possibilities consequently in favor of the shares when further discoveries are from time to time announced.

The following contracts have been entered into, viz., dated 15th March, 1888, between Robert Gordon Orr and John Brukowski of the one part, and Charles Henry Strutt of the other part; dated 17th March, 1888, between the same parties; dated 16th March, 1888, between Robert Gordon Orr of the one part, and Charles Henry Strutt of the other part; dated 17th March, 1888, between Rowland Bateman Smyth of the one part, and Charles Henry Strutt of the other part; dated 15th March, 1888, between Charles Henry Strutt of the one part, and Wilfred Hargrave of the other part; dated 9th April, 1888, between Charles Henry Strutt, the Vendor, of the one part, and Alfred William Browning, on behalf of the Company, of the other part.

The Vendor, who is the promoter, will pay all expenses attending the incorporation and registration of the Company, and also all underwriting, brokerage, commissions, printing, advertisements and expenses attending the issue of the Company's capital up to and including the first allotment. These and other arrangements which have been entered into by the Vendor with various persons, may technically constitute contracts within the meaning of the 38th section of the Companies' Act, 1867. Applicants for Shares must therefore be deemed to waive the insertion of dates and names of the parties to any such arrangements or Contracts, and, in order to prevent any questions, must accept the above statements as a sufficient compliance with Section 38 of the Companies' Act, 1867, and applications for Shares will be received subject only to this provision.

With reference to the above announcement, the Company having proceeded to allotment of shares in London, THE COMMERCIAL AND LAND MORTGAGE BANK, LIMITED, MADRAS, is authorized to receive applications for 2,000 shares (reserved for subscription in India) in the MADRAS PRESIDENCY DIAMOND FIELDS, LIMITED. The Rupee value of a share is Rs. 75, Rs. 30 being payable on application, further calls of Rs. 15 each being made as required, at intervals of not less than one month. Allotments in Madras will be made in order of application, telegrams taking precedence; the subscription list will be closed on Saturday, 18th June. Currency Notes of any Circle and Cheques on Indian Banks received at par.

Cheques on England also accepted if more convenient to subscribers. Forms of application and copies of Articles of Association obtainable from the Commercial and Land-Mortgage Bank, Madras, and from P. ORR AND SONS, Agents, Madras.

**PUBLIC WORKS DEPARTMENT,
AKRA BRICK FACTORY DIVISION.
NOTIFICATION.
SAND.**

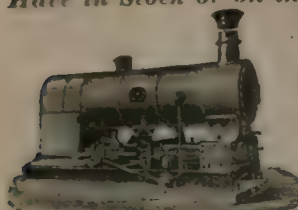
The right to excavate Sand for the period of 12 months from 1st June 1888 to 31st May 1889, from the Chur called "Buddertollah Sand Chur" being Holdings No. 1311 and 1312, 24P. Collectorate, will be sold by public auction on Thursday, the 31st May 1888, at 3 P. M., in the Office of the Superintendent of Akra Brick Factory, where particulars as to terms and conditions of sale can be learnt.

S. C. GHOSE, *Rai Bahadoor,*
SUPERINTENDENT,
Akra Brick Factory Division.
DATED AKRA,)
The 15th May 1888.)
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Obituary.

MACDONALD.—On 1st May, at "Blackhills," near Elgin, N. B. James MacDonald, C.E., aged 48 years.

LENNON.—On 17th May, at Mangalore, Lieutenant Richard Patrick Lennon, Assistant Engineer, P. W. D., of dropsy, aged 50 years.—English papers please copy.

GOODWIN.—On 19th May, at Vadai, Kathiawar, from apoplexy, Arthur Goodwin, Assistant Engineer, B. G. J. P. Railway.

INDIAN ENGINEERING.

SATURDAY, JUNE 2, 1888.

THE WATER-SUPPLY OF BOMBAY.

THE rapid increase in population, the development of the mill industry and the increased traffic of the Docks are combining to make the question of water-supply a very difficult one to deal with in Bombay. The Tansa Scheme is well under way, but it will not be completed for four years more. In the meantime we gather from the Third Report on the Prevention of the Waste of Water, submitted by Mr. Tomlinson, Assoc. M. Inst. C.E., the Deputy Executive Engineer in charge of Water Works, Bombay, that the number of connections is increasing at the rate of 500 per annum, and the consequent increased demand is about half million of gallons per day. The measures adopted for the prevention of waste, which were fully described in Mr. Tomlinson's previous reports, reproduced in these columns last year, have resulted in the saving of 24 millions of gallons per day, and in consequence the complaints of short supply are not so numerous this hot season as they have previously been. We think this is a satisfactory result of the adoption of the Deacon's meters and the thorough working of the system of detection of waste organised in connection therewith. Of course the saving of waste cannot go on indefinitely, and the available supply for the old and new customers in Bombay must become a fixed quantity until the Tansa water arrives.

The detection of waste within the City is being assisted by the stoppage of the leaks from the Vehar Lake Waste Weir which have been going on for many years. The puddle trench has been removed and is being replaced by Portland Cement Concrete. The work has been quickly done, but has been an anxious one, the water in the adjoining lake being several feet higher than the bottom of the trench excavated. We hope to further describe this work after it is completed.

Additional catch water channels are also being made at Vehar, to bring into the Lake the run off from hills adjoining its water-shed.

Investigations are also being made into the question of stopping the leakage from the Malabar Hill Reservoir, but the result of the inquiries (instituted, we believe, in consequence of an article in the *Times of India*) are not yet made public.

Every effort is, it appears, being made to conserve the present supply of water, until the new scheme is completed. It is not practicable, however, to refrain from extending the system of distributing mains. During the last year over 11 miles of mains from 12" to 3" in diameter were laid down. There are at present several important extensions in hand. One is the provision of an 18" main to supply the Docks and adjoining locality which have hitherto had a very insufficient supply. This work is practically completed and has resulted in a material improvement

of the supply. The estimated cost of the work is Rs. 85,000.

Another new main now being laid is a 27" main, eventually intended to convey Tansa water to the Malabar Hills Reservoir, when required; but is to be used in the interval to develop the discharging capacity of the only second main from Vehar, 24" in diameter, but now laid as far as Chinebpokli. This main is about 2½ miles long and involves three railway crossings and a bridge over the open storm water drain. It is expected the work will be completed in about three months. The cost of this work will be over two lakhs of rupees including the pipes and sluice valves which are part of the Tansa supply, manufactured by Messrs. Macfarlane Atrung & Co., of Glasgow.

The whole of these works are being carried out under the supervision of Mr. Tomlinson. We may congratulate Bombay that Major Tulloch selected for them the right man. We learn that Mr. Tomlinson was, before coming to Bombay, a Resident Engineer under Mr. Binnie, well-known as the Engineer of the Nagpur Water Works, recently described in our pages; and that he has been entirely devoted to water-supply to towns for several years past. Although Bombay will probably suffer from an insufficient supply during the next few years, we think its inhabitants may feel confident that the works are being skilfully managed.

DIAMOND FIELDS OF INDIA.

II.

THE next diamondiferous region is that known as the Kistna and Godavari (Golconda) Districts. The sites where mining operations have been conducted by the primitive operators are situated at Kallar, Wastapilly, Godavetty Kallu, Atkur Barthenypado, Partial, Mulla-villy and Golapilly. At Kallar, according to Tavernier, diamond-mining had in 1665, at the time of his first visit, attained extensive proportions and the hands daily employed numbered 60,000, consisting of men, women and children. The digging conducted by the men was confined to shallow depths, at which operations were discontinued on appearance of water. The *débris* created was removed by the women and children to a place assigned to it—a walled enclosure with graduated holes—where the wrought material was saturated for several days according to the nature of the stuff until it attained the consistency of batter, when by washing and letting out of the water the earthy substance disappeared leaving the sand behind. This arenaceous deposit, when dry, was winnowed and afterwards spread on the ground, and pounded with wooden rammers in order to cause further disintegration of parts. The earth or sand so prepared was again winnowed and then subjected to examination for diamonds. Flint-stones were formerly used in place of wooden rammers to the serious destruction and damage of the diamonds.

This may be said to have been the *modus operandi* of mining in the Kistna and Godavari Districts, with slight variation according to circumstances in the arrangement

for drainage and hoisting when the diggings attained greater depths.

The Partial group, which comprises Wastapilly, Godavetty Kallu and Monaloor, possesses characteristics of diamond-bearing strata, and is the supposed birth-place of the "Great Mogul." Tradition has it that cart-loads of diamonds were taken away from Godavetty Kallu! Golapilly, Malavilly and Bhadrachellum are other places where small diamonds have been found.

Chutia-Nagpur, in Bengal, possesses diamondiferous localities, and most of the finds were made in alluvial washings of the Tunk and its sister river the Koel. Single diamonds of the value of Rs. 40,000 to Rs. 50,000 have been found in this tract, and it is stated that the family of the Rajah of Chutia-Nagpur still possess one of Rs. 40,000 value.

Various authorities give various accounts of the district of Sambalpore, where diamonds have been known to occur. There is, however, some uncertainty as to the real limits of diamond-bearing soil, hence the wide difference in the description and location of these limits. The most reliable account we have yet obtained of this tract is that contributed in 1825 by P. Breton, Esq., Surgeon, who gives a list of 20 diamonds found in the Mahanadi between 1804 and 1818. One of these which weighed 672 grains or 210·6 carats was picked up at a place called Hera Kund in the bed of the Mahanadi, where and elsewhere mining was conducted by open washings. Bundelcund has become notorious for diamonds by the fact of possessing within its limits the famous mines at Punnah which rank next to those at Kamariya. The system of mining at Punnah in 1867, when Mr. Jules Schaumburg visited the place, consisted of a pit, from the bottom of which rose to the surface an inclined plane by which the workmen descended the mine. The water was pumped by means of a Persian wheel worked by four bullocks. The *débris* was raised in baskets by means of a tail rope and a pulley, and when the stuff was banked it was spread on stone slabs and searched; the searchers and the miners being alike placed under the charge of guards.

Kamariya is reported upon by several observers. The rocks which possibly imbed the precious gem are the conglomerate sandstone made up of pebble, imbedded in a rather fine matrix, the clay falls, and the brown sandstone with green siliceous rock. The Lower Rewah sandstones are traced to this field.

These are the few admittedly important localities which have received historical celebrity at the hands of travellers, scientists and other casual and deputed observers, and the wonder is that though these areas or regions have been known for over 200 years, until recently no attempt has been made to seriously pursue the industry in this country. Following up the wake of the Hyderabad (Deccan) Company we are glad to see started under the auspices of the eminent firm of Messrs. Orr and Co., the "Madras Presidency Diamond Fields Co., Ltd.," who bid fair sooner or later to raise the Wajra Kurur fields to the level of the Bultfontein and Jagersfontein mines of South Africa.

The history and the results of the Kimberley and

Griqualand West should awaken the lethargical section of the public to a sense of enterprise which the localities referred to in these pages from their past illustrious history would justify. There is doubtless something in the atmosphere of India which disintegrates human efforts or tames enterprise.

We have had iron smelting works started at various periods in widely apart localities which with one exception, now solemnly reproach the intelligence of the public, and the wisdom of our patronising Government.

Happily the industry we have written about is not dependent on the co-operation of the Indian Government, the evil genius of the country under whose benign provisions infant industries paralyse instead of thriving into a healthy manhood. With sustained efforts and persistent perseverance we hope to see the realisation of the results forecast by the promoters of the *new* Company, and as the barque of the enterprise is launched by such pre-eminent builders as Messrs. Orr and Co., we feel confident that it will have a prosperous voyage, and we wish it Good-speed.

[In our first Article the name "King" and should be replaced by *Brukowsky* in the two instances where it occurs in the tenth paragraph.]

THE MADRAS HARBOUR.

WHITE elephants are popularly supposed to be an exclusively Burmese speciality. But this is an egregious popular error, as most men know who have lived for any time on the Continent of India with their heads screwed on tight, and willingness to see things as they are. The Madras Harbour Works afford an instance—too much, alas, in point. They were commenced—with a good deal of trumpet blowing—considerably more than a decade ago. More than seventy lakhs of rupees have been expended on them: they are barely two-thirds finished even now; and they are a scandal and disgrace to the administration; a reproach to all concerned with their construction. They have been prosecuted on the plans and imaginings of an English Engineer without any local experience: it goes without saying that they are a costly failure; and worse. For such an undertaking topical knowledge was before all things necessary, above any other claims imperative.

The Madras authorities preferred a job; and now the Port Trust Board declare that they have on the spot a staff of Engineers who, for many years, have had the advantage of an intimate practical acquaintance with the harbour which, in its present conditions admits of completion within only very narrow limits of design, and they earnestly represent that all details, in reference thereto, should be settled on the spot by themselves, subject to the control of the Madras Government, who can instruct their Engineers to inquire into and examine any deviation from the sanctioned plan which it might be considered in the interests of the port to adopt. This would obviate the delays which have occurred hitherto through constant references to England.

The Board has evidently made out a good case. *Apropos*, we note that the Board is quite willing to sub-

ordinate its wishes to Engineering control, but at the same time it strongly urges that such control should rest with the local, locality knowing Government, and not be relegated to far-away, practically foreign, and in the nature of things unsympathizing authorities, ignorant and careless of local conditions and needs. It is sensibly urged that Mr. Parkes is not sufficiently acquainted with the port of Madras to enable him to form a correct opinion as to its requirements, and that it must needs be difficult, if not impossible, for a man, however skilled in his profession, and naturally gifted, to arrive at adequate estimate and judgment of the work needing to be done at a place lying so far from his ken, so widely remote from his otherwise acquired experience. The members of the Board, we are told, approve unanimously of the decision of Sir John Coode, and Admirals Salmon and Nares and—since there are conflicting judgments on the subject—they claim a right to act upon the one which best coincides with their own views. We should like to know how, in the name of commonsense, any sensible man can take it on himself to gainsay such an argument, backed as it is by the admitted fact that the staff of local Engineers is both competent and experienced. Government chooses, however, to ignore these and other cogent representations of local fitness and worth; ignores them, and confines itself to the financial aspect of the question. Much of the arrogance of his double-barrelled Grace of Buckingham and Chandos, and of the insouciance of Sir Mountstuart Grant-Duff still pervades Madras Secretariats. A few questions in a House of Commons, that is now beginning to take a *real* interest in Indian affairs, will probably intervene before long to subvert this antiquated tradition.

Something *must* be done; and the sooner it is done the better it will be for economy's sake, as well as in the interests of the public. The Madras Press seems to think that the strongly worded letter addressed by the Madras Harbour Trust to Government must needs elicit a reply from the India Office as to the Engineering question involved. We trust that our contemporaries' hopes will meet with suitable fulfilment.

Meanwhile, public opinion on the subject should find expression more extensively than it has done as yet. The apathy of the Madras public with regard to the harbour works that are so needful to establish the port as a first-class flourishing one, and to rehabilitate the drooping prospects of trade, is practically as much to blame for past failures and inaptitudes as the shortcomings of the Secretariat are.

The Harbour Trust Board, we notice, adheres to its resolution as to the necessity for a north-east entrance, and holds fast to an opinion that smooth water is absolutely necessary to make the harbour a success. Failing such means it cannot be regarded as a harbour refuge from a cyclone. In order to such end the safety of lighters, jetties, cranes, &c., is absolutely essential. Such an end would not be attained by the arrangement proposed by Mr. Parkes from his English coign of vantage, and with his lack of local knowledge.

Notes and Comments.

ELECTRIC LIGHTING IN CALCUTTA.—We are informed that the Agent of a well known firm at home has contracted for lighting the United Service and Bengal Clubs with the electric light at an early date.

OPENING OF THE SAMARCAND RAILWAY.—The railway from the Caspian to Samarcand was opened on the 27th May. The ceremonies and rejoicings were of an elaborate character. Many Europeans were present.

AN IMPORTANT CIVIL BUILDING.—An estimate, amounting to Rs. 1,89,970, for constructing a Collector's office at Calicut, is sanctioned. The design is susceptible of improvement, the Chief Engineer thinks, who also considers the rates as excessive. What are the functions of the Consulting Architect?

BOMBAY FOREST ADMINISTRATION.—By far the most important feature in the forest history of Western India for the year 1886-87 was the decrease of net revenue by nearly 4½ lakhs. An increase is reported in Sind alone, and it appears to have been due mainly to an increased supply of fuel to the North-Western Railway.

ARTIFICIAL STONE.—The Burrakur Iron-work's slag is being turned to good account in the manufacture of artificial stone at Sealdah, Calcutta. We believe that pulverised slag and Portland cement are the only ingredients used, and these are combined under pressure. The outcome is pronounced highly satisfactory.

PORT TRUST FOR ADEN.—In answer to Sir. R. Temple Sir J. Gorst said in the House that the establishment of a Port Trust for Aden has been for some time under the consideration of the Government of India; but no intimation has yet been received that the question is settled, or a Port Trust in existence. Dredging is going on meanwhile under the orders of the Government of Bombay.

PORT ARTHUR.—News from Port Arthur states that a leakage has taken place through or under the coffer dam of the steam basin, which has proved too much for the pumping machinery to cope with, and there are said to be 5 feet of water now on the floor of the basin. This accident will probably somewhat delay the completion of the works, which otherwise were reported to be progressing rapidly.

SOMETHING WRONG SOMEWHERE.—The revised estimate, amounting to Rs. 32,725, for constructing lines for the City Reserve Police at Pudupet, Madras, is sanctioned. The original estimate was Rs. 27,785. The Government consider it very unsatisfactory that an estimate should have been passed by the Executive Engineer containing errors representing a sum of Rs. 4,526 out of a total excess of Rs. 4,940.

THE BENGAL P. W. D. ESTABLISHMENTS.—We hear that Mr. Anley goes on leave early this month, and will not return. This, coupled with Mr. Martin's promotion, will relieve the present block in promotion, which will be further relieved should Mr. Wickes get one of the minor Secretaryships now vacant. We are informed that Mr. Toogood shortly goes on privilege leave, and that Mr. Cleghorn is wasting his inventive talent in an unimportant office.

COMMUNICATIONS IN LOWER BURMA.—Work on the new bridge at Pegu will have to be abandoned for the season in consequence of certain iron work not arriving from Bombay. The scaffolding which has been put round some of the piles will be removed, as when freshes occur with heavy rain vast amounts of timber, bamboos,

branches of trees, and rubbish come floating down the river which would, if stopped by the scaffolding, affect the safety of the bridge.

LEGISLATION IN THE RIGHT DIRECTION.—We notice from the batch of papers received from the Benighted City that the Act of the Local Government empowering the District or Municipal Boards constituted under the provisions of Act IV. and V. of 1884 (Madras) or other such law, to guarantee interest on, or to create a fund for repayment of, capital expended on any work to which the funds may be applied, has received the assent of the Imperial Government.

RUSSIAN VERSUS AMERICAN PETROLEUM.—The first shipment of Russian petroleum arrived at Singapore about the 28th April from Batoum. The steamer brought in all about 90,000 cases, of which 30,000 cases were landed in Penang. Says a local paper: "The packing of the oil in tins and cases is exactly the same as that of American oil and the quality proves to be superior, the official test shewing an average flashing point of 78° against 71° for American oil."

THE COMING RAILWAY.—The proposals of the "Great Western Railway Company of India," as it is now called—the project for a line of more direct communication between the North-West and Karachi—are now before the Government. It seems probable that a survey of the so-called deserts of Rajputana will take place during next cold season, without which the recommendations of the military authorities for a strategical line of some sort can scarcely take practical shape.

ITEMS FROM BURMA.—Mr. G. E. Thomas, Locomotive Superintendent, Burma State Railway, has applied for permission to cancel his furlough and return to duty. It is believed that Mr. H. F. White, Superintending Engineer, under orders for transfer from Hyderabad to Burma, will relieve Major T. Gracey, R.E., who goes on leave, and whose head-quarters are at Mandalay. This will be the first step toward the amalgamation of Upper and Lower Burma as one public works charge.

SEEBPORE ENGINEERING COLLEGE.—The parents of some of the students in the mechanical apprentice section of this institution are much exercised by the new arrangement under which a *subordinate* takes charge of the workshops, and will thus have to certify to the practical qualifications as *workmen* of those who have served their time in it. It is believed that the value of the certificate will be depreciated in comparison with those heretofore signed by executive officers.

WHO IS TO BLAME?—It would appear that the town of Madura is at present not enjoying that pleasant sanitary condition which is the *sine quâ non* of hygienic existence. The drainage is reported as imperfect, seriously impeded and foul—requiring thorough remodelling; and the water-supply as defective and ill-arranged for the insurance of pure and wholesome water. We trust the civic fathers of Madura are not following the retrograde example of their Calcutta brethren, in whose hands like works have seriously suffered for the lack of energy and zeal.

THE DARJEELING-HIMALAYAN RAILWAY.—The Darjeeling paper says:—"It will interest the shareholders of the D.-H. Railway and all concerned in the District to learn that the G. O. M. has become a large purchaser of shares in our little Railway Company. However we may differ politically with Mr. Gladstone, there is no doubt about his knowledge of finance and of the value of securities, and we congratulate the shareholders on

having such a noble co-proprietor." We have incidentally learned that some difficulty has arisen in respect to participation of profits by Government, and that the point is enshrouded in doubt.

THE OUDH AND ROHILKUND RAILWAY.—A contemporary observes that the Secretary of State in Council is understood to favor the eventual transfer of the Oudh and Rohilkund Railway to a new company. If this view is to obtain, the East India and the Bengal and North-Western Railway Companies, both of which had submitted offers to take it over, work and extend it, are put out of court. The present O. and R. Company, reconstructed with a good backing, and the advantage of being the man in present possession, are making great efforts to renew their hold; whilst an entirely new company, which offers to provide considerable additions to the present line, is also in the field.

ARMY NEWS.—The following is Royal Engineer Corps news:—Colonel H. C. Chermiside, C.B., C.M.G., has been appointed Vice-Consul at Erzeroum. He was Vice-Consul in Asia Minor from 1879 to 1881. The following officers of the Indian Establishment have joined the School of Military Engineering, Chatham, for instruction under the new regulations:—Major M. Langharne, Brevet Major St. G. C. Gore, Captain R. O. Lloyd, Captain O. V. Boddy, Brevet Major C. B. Wilkinson, Captains W. T. Shone, D.S.O., W. H. White, B. Scott, E. Glennie, H. S. Andrews Speed, and G. M. Porter. Embarkations:—For Ceylon—Captain H. L. Jessop. For Gibraltar—Lieutenant R. S. Cartis.

THE BENGAL-NAGPUR RAILWAY.—We learn that the large bridges at the Bilaspur end are of the ordinary type, some of them having 150' spans. Two bridges are large, one being 14 spans, the other 9 spans, but the details are nothing out of the common. The only point about the latter bridge (the Seonath, between Nandgam and Raipur) is that the whole bridge has been completed in one season—at least it will be by the end of June. One interesting piece of work next season will be the removal of 9 spans of meter gauge girders, replacing them with B. G. girders, in which operation probably some special arrangements will be used. This bridge is the one over the Wenigunga River. At the present moment rails are laid some 30 miles beyond Raipur between Raipur and Bilaspur, and work is in hand along the whole system including the branch from Bilaspur to Kutni.

BURMA P. W. D.—We understand that in the new organization of the P. W. D. in Burma, the Chief Commissioner has made a special point of having Superintending Engineers of Burman experience. Mr. H. F. White, M.I.C.E., at present Superintending Engineer and Secretary to the Resident, Hyderabad, is one of the Superintending Engineers selected for Burma. This cannot be very much to that officer's liking we should think. Mr. White's successor at Hyderabad is not yet appointed. The re-organization of the clerical establishment of the Hyderabad P. W. D., proposals regarding which were submitted to the Government of India about seven months ago, has received the approval of the Government of India. The measure secures a moderate but steady incremental promotion to clerks all through their service, and its introduction has given great satisfaction.

A MARVELLOUS PERFORMANCE.—The reclamation of Lake Abukir, situated on the borders of the Mediterranean, and covering 31,000 acres of land once highly cultivated and thickly populated, may now be considered a

fait accompli. The pumping machinery, iron buildings and other iron-works were constructed by the well-known firm of Messrs. John and Henry Gwynn of Hammer-smith, London, from designs by Mr. James Abernethy, F.R.S.E., Past President, Inst. C. E. The pumps were started on 8th March last, and by the 23rd the lake was dry, the water, 2,900,000,000 gallons, having been pumped off in 456 hours with a consumption of 135 tons of coal; equal to raising $21\frac{1}{2}$ million gallons 6 feet high per ton of coal or 9,600 gallons of salt water the same height for each pound of coal fuel, or in other words one pound of coal sufficed to raise 96,000lbs. of water 6 feet high.

THE CEYLON RAILWAY.—It was declared in the House that the Secretary of State has sanctioned an extension of the existing Ceylon Railway from its present terminus at Nannaya to Haputale, a distance of $25\frac{1}{2}$ miles. It has been decided, on the strong recommendation of the Governor and the Consulting Engineer, not to introduce a break of gauge on this the last section of a line 158 miles long. The estimated cost of the extension, if executed by contract, is £17,500 per mile, but the Consulting Engineer anticipates that this will be reduced to £17,100 per mile if the work is executed departmentally. The conditions in this instance are specially favorable to the departmental system, the adoption of which has been forcibly advocated by the Governor on the grounds of economy and expedition. In these circumstances there is no intention of inviting tenders for broad and narrow gauge lines.

PROVINCIAL AND LOCAL ESTIMATES FOR 1886-87, N.-W.P. and OUDE.—We gather from a recent Resolution of the Government of N.-W. P. and Oude that the figures of the year under notice, as finally closed, shewed an improvement under the head of Receipts, Local and Provincial, by nearly 21 lakhs, as compared with 1885-86, the increase being almost wholly 'Provincial.' The largest increase appears under Land Revenue, which amounted to Rs. 1,56,14,000, against Rs. 1,42,95,000 of the previous year. The State Railway credits shewed an improvement to the extent of Rs. 3,43,000, due to opening of the Lucknow-Sitapore Railway, and the enlarged working of the Cawnpore-Achneyra Railway. The receipts under Irrigation are steadily growing under the excellent management and increased demand for water, and the increase of the year under this head amounted to Rs. 2,29,000.

THE PAMBEN CHANNEL.—News has reached Pondicherry that the contract for the construction of the Pamben Channel Works has been arranged between the London Directors and a French firm of contractors upon the revised plans and altered estimates of Monsieur Poilay, Civil Engineer, who was sent from Paris to India about a year ago, to explore and report on the land and country through which the Canal is to pass. Active operations on the Canal will probably not begin until after the close of the north-east monsoon. Preliminary works, however, will most likely be commenced much earlier. It is calculated it will take four years to complete the Canal. It seems so strange that large contracting firms in England should have allowed this work—representing an expenditure, wholly in British territory, of nearly one million of pounds sterling—to pass into the hands of foreigners.

RECENT ADVANCES IN WATCH-MAKING.—In the domain of mechanical science and practice as applicable to watch-making, Messrs. Marks and Co., of Bombay, have introduced novelties which should commend themselves to

the notice of all lovers of accurate chronometers. Their "campaign watch," whilst combining the best materials, workmanlike finish, simplicity of construction, and a powerful lever movement, is cheapness itself. Ingenuity, however, has not halted at this triumph, which is comparatively small and insignificant, as compared with their astronomical watch valued at Rs. 8,000. Provided with a delicate chronograph action, it is capable of exhibiting at a glance the second, the minute, the hour, the day of the week, the month, the phases of the moon, and the time of the principal cities of the world. This may well be termed an achievement of human thought and labor.

HONG-KONG PEAK TRAMWAY.—The inauguration of the line will soon take place as the preliminaries are completed. The testing of the safety appliances has proved satisfactory. The efficacy of the gripping gear we learn was subjected to a severe experiment, the weight of the carriage and the speed at which it travelled being both greatly in excess of the traffic requirements. The test was applied at the steepest part of the line, where the gradient is 1 in 2. The effect was to bring the heavily-laden and fast-travelling carriage to a complete standstill in a few feet, the leading truck which was attached to the rope from the engine-house continuing its journey down the hill. The gripping gear, it appears, proved not only sufficient for the very trying strain put upon it, but even went so far as to err on the side of safety, as it was found afterwards that it could not be detached without the use of appliances that were not at hand at the moment.

TECHNICAL EDUCATION IN INDIA.—Mr. Alfred Chatterton, B. Sc. has been appointed Professor of Engineering to the College at Madras. The selection was entrusted to a committee, appointed by the Secretary of State for India, which consisted of Sir Alexander Taylor, Principal of Cooper's Hill College, Professor Unwin, of the City and Guilds of London College, South Kensington, and Sir Philip Magnus, Secretary and Director of the City and Guilds of London. The committee recommended two gentlemen, and of these Mr. Chatterton was selected. Mr. Chatterton received his preliminary education at St. Mary's College, Peckham; he subsequently studied at Finsbury Technical College, where, amongst other distinctions, he gained the Cloth Workers' exhibiton and numerous medals. Mr. Chatterton's practical knowledge has been obtained at the locomotive works of the London and South-Western Railway at Nine Elms, where he has also been engaged in teaching the apprentices' evening science classes.

HYDERABAD-DECCAN ITEMS.—Syed Ali Hussan, Officiating Revenue Settlement Officer, is appointed to be a member of the Irrigation Board during the time he holds that office. Mr. Heenan, Superintending Engineer, has recommended that, as an experiment, the irrigation of the Eastern Division should be made over to the Senior Executive Engineer. Messrs. Taylor, Bridges and Schoeffer, Assistant Engineers, N. G. S. Railway, have been transferred from No. 2 Section and posted to do duty on the new open line. It is expected, unforeseen circumstances apart, that the Railway extension to Bonakullu, a distance of about 32 miles, will be thrown open to public traffic on or about the middle of July. Mr. Furnivall has left for Simla; the object of his trip appears to be a consultation with His Excellency the Viceroy in the interest of the line at the present crisis. The sinking

of an artesian well in the bed of the Husain Saugor, near Nalaguta, which is to supply daily about 50,000 gallons of water for consumption, has been suddenly brought to a standstill by an accident.

STATE RAILWAY SUPERIOR REVENUE ESTABLISHMENT.—We regret to learn that the Government of India are now afflicted with a surplus of traffic and locomotive officers, and are at their wits' end to know what to do with them. The most of these gentlemen are on the "non-pensionable" establishment, and at the present financial crisis we would suggest that advantage be taken for getting rid of the inefficient and least successful officers by giving them the usual notice, just as a guaranteed railway would do. It is also possible that the State has "pensionable" officers that come under the same category, and are oblivious to the fact that a State railway must be worked as a remunerative concern, and this desirable end cannot be attained so long as Government persist in the maintenance of extravagant and inefficient officers, and annually give increments to their salaries as a matter of course without ever raising the question as to whether they are really worthy of it. We would recommend the compulsory retirement of such to the serious consideration of the Government of India.

THE STATUE OF THE LATE MR. THOMAS ORMISTON, C.I.E.—The statue of the late Mr. Thomas Ormiston, who designed and successfully carried out the construction of the Prince's Dock in Bombay, has finally been erected in the University Gardens at the east of the Sir Cowasjee Jehangeer University Buildings, and will be unveiled this afternoon by Sir Henry Morland. The statue is the work of Mr. John Mossman, a member of the Royal Scottish Academy, who has produced some excellent and artistic statues, among them being the one erected in memory of the late Dr. Livingstone, the great African traveller. The statue, which is of the finest statuary marble, including the plinth, is about 6 feet 4 inches high, the pedestal, which is of Sicilian marble, being 4 feet high. The pedestal rests on a plinth of Bombay basalt, which is about 2 feet high. The statue represents the deceased standing erect with a note-book in his left and a pencil in his right hand, as if he is about to take notes of things that he sees around him. Those of his friends—and there are a host of them—who have seen the statue pronounce it to be an admirable likeness.

THE Gazette.—This week's P. W. D. Notifications are of rather more than ordinary interest and importance. Colonel J. Steel, R.E., is appointed Chief Engineer to the North-West Provinces Government in the Public Works Department, in succession to the late Colonel Ward, and a better selection could not have been made. Colonel Steel is deservedly popular with all branches of the Department, and is one of the "coming" men in it. Lieutenant-Colonel W. Cumming, R.E., is appointed Chief Engineer Burma. Colonel Cumming is fortunate for a Superintending Engineer, 3rd class (temporary, 2nd class.) He however possesses the desideratum of local knowledge which could not be well ignored. Mr. E. Martin is appointed to officiate as Chief Engineer to the Bengal Government, in the Public Works Department, Building and Roads Branch. We have already expressed our views on this appointment—anent which there can be no divergence of opinion. Mr. H. White is appointed Superintending Engineer in Upper Burma, to which Province he is transferred from Hyderabad, Deccan. This is negative promo-

tion, and, under the circumstances, a most unfair change.

THE MYSORE P. W. D.—Recently the Secretary to Government of Mysore, D. P. W., submitted a revised scale of Engineer establishment for the local D. P. Works, which the Durbar has sanctioned. Under this revision the following promotions take place: Mr. T. Inman, Executive Engineer, 1st grade, Rs. 600 to Rs. 750 per mensem; Messrs. R. T. Scaldwell and V. H. Karvi, Executive Engineers, 2nd grade, Rs. 500 to Rs. 600; Mr. E. R. Soobarayer, Executive Engineer, 3rd grade, Rs. 400 to Rs. 500; Mr. D. Sitarama Row, Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, Rs. 300 to Rs. 400; Mr. K. Prabalada Row, Assistant Engineer, 3rd grade, to 2nd grade, Rs. 200 to Rs. 250; and Mr. B. Subba Row, Apprentice Engineer to Assistant Engineer, 3rd grade, Rs. 150 to Rs. 200. The promotions among the Upper Subordinate Grades are Messrs. C. A. Welsh and J. King from Supervisor, 2nd grade to 1st grade; Mr. A. Munisawmy Moodliar from Supervisor, 3rd to 2nd grade; Messrs. W. Runga Row, A. Ramalinga Moodliar and A. Jaganatha Moodliar, from Overseer 1st grade to Supervisor, 3rd grade, and several minor steps to other Overseers.

RAILWAY MATERIAL AND HARBOUR DUES IN INDIA.—The Marquis of Hartington asked the First Lord of the Treasury, whether the Government had come to any determination, which he could communicate to the House, with respect to the exemption from the payment of dock and harbour dues, now claimed by the Government of India, on shipments of material intended for the construction, maintenance, or use of railways in India. Mr. W. H. Smith replied that the Secretary of State in Council for India has come to the determination that in future exemption from dock and harbour dues be not claimed on the following classes of goods shipped from Great Britain or for ships carrying them, on account of the Government of India: 1, coal; 2, all rolling-stock for railways; 3, permanent-way for railways; 4, all goods manufactured in this country for use on Railways, or being of such a nature that they cannot be used except for railway purposes. Mr. Sinclair asked whether the word "dues" was intended to include rates and whether "coal" included coke. Mr. W. H. Smith replied that I have read from the text of the resolution passed in the India Council, and I have no doubt whatever that coal would include coke and that dues would include rates.

A FEAT IN ENGINEERING.—The statistics connected with the magnificent bridge over the Nerbudda, which was commenced on 7th December 1877 and completed on the 16th May 1881, will not be devoid of interest to the profession. It consists of 25 spans of wrought-iron girders of 180 feet, resting on cast-iron columns tapering from 14 feet to 10 feet, each column being sunk to an average depth of 123 feet below rail level. The total length of the bridge is 4,687½ feet. The weight (aggregate) of cast-iron 6,542 tons, of wrought-iron 6,692 tons, or a little over 3 tons of metal used per foot run. To sink the columns as much as 41,384 tons of top weighting was required beside the combined weight of the columns and the concrete they contained, which amounted to 19,949 tons, giving a total of 61,313 tons. The depth of the foundations of the columns under the bed of the river varies from 55 to 104 feet and 74 to 105½ feet

under low water. The ordinary columns were completed in 200 days; the deeper ones in 750 days. The cost is put down at 38 lakhs or Rs. 810 per foot run. The Engineers whose names stand forth in relief in this connection are Messrs. George Bayly and Hargreaves, and they may well be proud of the fame achieved and monument reared in India of English skill and power.

THE TOUNGOO-MANDALAY RAILWAY.—A correspondent writes:—Except the break in the line at the Myit Nale River, ten miles below Mandalay, this line might be opened throughout for goods and passenger traffic. A temporary timber bridge had been constructed over this river upwards of twelve months ago, in the site of the permanent bridge, but this proved so flimsy a structure that nothing but foot passengers and trollies have ever been permitted to cross it since completion. The piers of this temporary bridge were so designed as to leave sufficient space inside the piers for the cast-iron cylinder piers of the permanent bridge, but when work was commenced on the latter and the rivers bed disturbed, the piles of the temporary bridge became loose and naturally enough subsided, taking the superstructure with them. This was a result which the merest tyro might have foreseen and avoided. The permanent bridge, consists of four 150' spans, with two abutment spans, apparently of 50' to 60' span, thus making the total length of bridge some 700'. The cylinders of the permanent bridge, it is understood, have been sunk some 8" to 9" too low, and are not quite perpendicular, although there is a resident Executive Engineer on the work. On the 11th and 12th instant (May) one solitary hammer might have been heard at work on the bridge, although the girders were (some at least) laying on the platforms ready for rivetting, but the work is practically at a stand still. This probably means rapid progress.

BURMA PROVINCIAL P. W. D. UPPER SUBORDINATE ESTABLISHMENT.—The following *permanent* promotions are ordered with effect from the 1st April 1888:—Sub-Conductor J. Watson, from Sub-Engineer, 2nd grade, to Sub-Engineer, 1st grade; Baboo R. D. Bhattacharjee, Rai Sahib, from Sub-Engineer, 3rd grade, to Sub-Engineer, 2nd grade; Mr. D. K. Macdonald, from Sub-Engineer, 3rd grade, to Sub-Engineer, 2nd grade; Mr. S. H. Cully, from Supervisor, 1st grade, to Sub-Engineer, 3rd grade; Mr. E. W. Bell, from Supervisor 1st grade, to Sub-Engineer, 3rd grade; Baboo Chundun Lall, from Overseer, 1st grade, to Supervisor, 2nd grade; Mr. A. C. Martin, from Overseer, 2nd grade, to Overseer, 1st grade; Mr. C. O'Leary, from Overseer, 2nd grade, to Overseer, 1st grade; M. Raju, from Overseer, 3rd grade, to Overseer, 2nd grade.—The following *temporary* promotions are made with effect from the 1st April 1888:—Sub-Conductor J. Devine, from Sub-Engineer, 2nd grade, to Sub-Engineer, 1st grade; Shere Mahomed, from Sub-Engineer, 3rd grade, to Sub-Engineer, 2nd grade; Sergeant W. Whiteley, from Supervisor, 1st grade, to Sub-Engineer, 3rd grade; Baboo H. C. Chatterjee, from Supervisor, 2nd grade, to Supervisor, 1st grade; Sergeant G. Bass, from Overseer, 1st grade, to Supervisor, 2nd grade; Mr. G. W. Beveridge, from Overseer, 1st grade, to Supervisor, 2nd grade.—The following Upper Subordinates on probation are confirmed in their respective grades:—Mr. A. M. Beatson, Supervisor, 2nd grade; Mr. A. F. D'Silva, Overseer, 1st grade.

Current News.

MAJOR CONNOR, Executive Engineer, Mhow Division, died of small-pox last week.

THE Secretary of State is inclined to lease the Oudh and Rohilkund Railway to another Company.

OWING to an accident to the main gas pipes, Colombo was in darkness on the night of the 9th instant.

THE Kyauknmyoung road, Upper Burma, is just being dressed, but as to when it will be metalled is unknown.

A NOTE by Sir Theodore Hope on the Public Works Department will be issued with the Finance Committee's Report.

LIEUTENANT LAWRENCE, R.E., is posted to Meean Meer for duty in the Sirhind and Lahore Command, Military Works.

THE Government of India has ruled that a military officer receiving a consolidated salary is liable to Income-tax on any portion of his salary.

AN official monograph on the brass and copper ware manufacture of the Punjab has just been published, which is of some considerable interest.

LIEUTENANT-COLONEL W. J. HEAVISIDE, R.E., Deputy Superintendent, 2nd grade, Survey of India, has applied for permission to retire from the service.

THE experiences of Mr. Griesbach, of the Geological Survey in Cabul, are said to be encouraging, as he has been received and hospitably treated everywhere.

LIEUTENANT G. A. TRAVERS, R.E., is transferred from the Sirhind and Lahore Command Military Works, to the head-quarters of the Inspector-General of Military Works.

ANOTHER proposal has been made to Government for a line of rail between Ambala and Kalka. The proposal is for a line of two feet gauge all the way up to Simla.

THE construction of the tramway to connect the Mysore Railway station with the Maharaja's Palace is being pushed on rapidly. The rails have been laid already half-way.

A PRIVATE telegram states that Mr. H. S. King, M.P., has obtained first place on the 8th of June for his motion regarding the grievances of the Uncovenanted Service.

CAPTAIN J. SHAKESPEAR, Leinster Regiment, and Lieutenant Atkinson, R.E., have proceeded to Diamond Harbour on reconnaissance duty in connection with the Hooghly defences.

WHAT may be called "works of necessity" on the Landi Kotal plateau are to be carried out during the current year, special regard being paid to the provision of a good water-supply.

ABDUL HUQ has secured a compromise with the Nizam's Government by the return of the shares purchased in the name of that Government and the refund of the money he paid for the shares.

THE Hall and Clock-tower at Multan started some time ago do not seem to be making much progress, and the fine clock presented by Lord Northbrook is still lying packed away in boxes somewhere or other.

UNDER the provisions of the Steam Boiler Inspection Act the Executive Engineer and the Chief Engineer of the Government Condensers, Aden, have been appointed Examiners under the Act for that port.

FROM an advance copy of the last half-yearly Report of the Rohilkund and Kumaon Railway Company, we gather that a dividend of £2.5 per cent, for the six months, free of Indian and English Income-tax, was to be declared.

THE construction work of the Mysore Portion, S. M. R., is carried on under the supervision of Mr. P. Scott, Executive Engineer. A construction train is now constantly working between Bangalore and the construction points.

THE Murree Brewery Company are building a new Brewery at Pindi, on a fine site just outside cantonments. It promises to eclipse even their Brewery at Gora Gully, which is quite a show place, and is to be ready for work by the winter.

THE Bombay Port Trust complain that the Municipal Bill which now awaits the sanction of the Viceroy alters the position of the Trust in regard to assessment for Municipal purposes in a manner that threatens to be seriously detrimental to the trade of the Port.

THE sickness of the market for Indian Mining Companies' shares has been aggravated by a report that the Mysore Mining Company's directors will not recommend a dividend in their forthcoming statement, but will ask for more money to carry on the work.

MUCH discontent is prevalent among the employes of the Southern Mahratta Railway owing to delay in the payment of wages. The salaries for April have not yet been disbursed. The blame is attributed to the Dharwar audit office, where the work of checking pay bills is delayed.

THE old Fort, Multan, is to be handed over to the Civil authorities as soon as that awful place—"the defensible post"—is ready. On this latter an enormous sum of money has been spent, some people say wasted; and a hotter or more undesirable place of residence it is hard to imagine.

A BOMBAY paper says:—"A tender for some lakhs of the new issue for the Tansa five per cent. loan has been made at 105½. When this loan was first issued a couple of years ago the highest tenders did not exceed 95; so that it is obvious that the Municipal credit is going up by leaps and bounds."

THE Sanitary Commissioner of Madras recently addressed his Government with regard to the carrying on of wet cultivation in close proximity to towns and villages, and expressed his conviction that the uncontrolled manner in which such cultivation is carried on in that Presidency, must be highly prejudicial to the public health.

It is said that the Secretary of State, although he has rejected the proposal to pay the Uncovenanted Service pensions at a fixed rate of exchange, is disposed to allow two years leave in 20 to count towards pension, also for the service to count from the age of 21 instead of 22. The Government of India, it is believed would support these proposals.

WARRANT officers may, on the recommendation of the head of their department, be permitted to retire before completion of the period of service qualifying them for pension, provided the conditions are observed as to length of service as laid down for soldiers of the British Army obtaining free discharge in War Office Army Circulars, clause 63, of 1873 and Royal Warrant, 1884, Article 588.

A BOMBAY paper offers a timely warning to unsuspecting handicraftsmen on that side of India, who may expect to find the Indian Midland Railway a fresh field for employment. They should get rid of the notion, for at Jhansi, we believe, there are now hundreds of Europeans and natives who besiege the railway offices and workshops for work without success or hope of any, and the consequence, in some cases, has been serious.

THE conclusion likely to be arrived at regarding the extension of the railway to Jamrud is, we believe, that the present cantonment terminus at Peshawur should be given up and the line be run from the city station almost due west to Hari-Sing-ka-Burj, thus passing to the north of the cantonment boundary. Its future extension to Landi Kotal by way of the Mullagori country is a possibility too, as Mr. Baker's recent survey of that route shews that such a project is quite feasible.

COLONEL MARSHALL, Superintending Engineer, Rajputana Agency, has arrived at Indore from Ajmere, and Mr. Harris, the Engineer in charge of Sindia's P. W. Department from Gwalior. The former makes over all the roads and buildings which are in Sindia's territory to the latter. The office of the Superintending Engineer, Central India, has been amalgamated with the Rajputana Agency, and will be removed to Abu as soon as the buildings for the staff have been completed.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

AGRICULTURAL SHOWS.

SIR,—Two or three years ago I took out a patent for a sugar-cane mill, and last year I exhibited the said mill at several of the Agricultural Shows of Northern India, in nearly all of which I received the second prize, but as in every case my mill extracted more juice from a given quantity of cane, and nearly always in a shorter space of time, I think that I was entitled to the first. I therefore wrote and protested against the decision of the Committee to the President of the show, but never obtained any satisfaction.

These agricultural shows are held in Northern India every year, and agricultural implements are occupying a more conspicuous place, but the persons who are appointed to decide on the merits of the said implements do not understand how to do so. I think that the Engineer of the station should always be appointed a Member of the Committee, and the points which are to decide the superiority of one machine over another should be published beforehand. Should you like to take up the matter in your paper, I will furnish you with full particulars as to what was done in the last Agricultural Shows of Saharanpur, Meerut and Muradabad.

NAHAN FOUNDRY;
23, May 1888.

F. R. JONES,
State Engineer.

[We should like to hear again from our correspondent on this subject, which is of general interest, having exercised public opinion much of late.—Ed., I. E.]

C. E. INEQUALITIES.

SIR,—In your last number (dated 26th May) you referred to the "Resolution" relative to the grading of R. E. Subalterns on their first appointment to the P. W. D., the object of which was to overcome the disadvantages they labor under in comparison with Engineers appointed from Cooper's Hill and elsewhere. We the Civil Engineers do not regret this question of inequalities is being taken up, as we do not grudge any benefits bestowed on the Military members of the Department, knowing that before long we, doing the same work, must receive the same emoluments.

There are some eighty Royal Engineers in the Military Works Branch. Do these men draw additional Military allowances equal to those of their brother officers engaged on purely Civil Engineering Works? We would not think so. We however pause for a reply.

Again, do Majors Langhorne, Gore, Wilkinson, and Captains Lloyd, Boddy, Shone, White, Scott, Glennie, Speed and Porter, attached to the Railway and other Branches of the P. W. D., and now at the School of Military Engineering, Chatham, count the time spent there as ordinary furlough or special leave, and is their pay, (full pay we believe, and in sterling) during that time charged against the Indian revenues? We ought not to think so, but we must once more pause for a reply. In these hard times we do not think the Royal Engineer has either too much pay or too many privileges, but if additional privileges are bestowed on him merely because at *fêtes* and *levées* he dons a uniform in which he feels uncomfortable, by all means let the whole Department have a more or less fancy costume, with or without unmeaning titles. We Civil Engineers will think the discomfort is cheap at the rate of an additional hundred or two a month, and may be depended upon for voting solid in its favour, if the matter is ever referred to us.

It is unnecessary to point out that the course of study at Cooper's Hill and elsewhere is longer than that prescribed at Woolwich, and is not broken up by purely Military subjects; consequently any additional Military information is more than counterbalanced by a want of theoretical and practical Engineering knowledge.

"ONE AND FOUR PENCE."

P. W. GRIEVANCES.

SIR,—I shall begin this in a similar manner to that of your correspondent "A Sub" in your issue of the 12th instant.

I was no less surprised to read your correspondent's remarks against Rai Prosuno Comar Banerjee Bahadur, which to any man of commonsense were quite uncalled for. If your correspondent, who signs himself "A Sub," is actually a Subordinate of the P. W. D. he must know that the aim of every subordinate (be he European or Native) is to endeavour by long and faithful service to get the highest amount of pension procurable—small it may be after a life spent in the service. Babu P. C. Banerjee will at the end of nearly 34 years' service obtain the minimum pension, whereas if interlopers had not been forced on the Provincial Branch he would have had after 30 years' service the maximum pension of Rs. 250 per month. I agree with your correspondent that there is great discontent in the Subordinate grades, and I feel sure, if the grievances complained of are placed before His Honor the Lieutenant-Governor of Bengal, he will endeavour to mitigate the same.

In the Classified List of Officers of the P. W. D., corrected up to the 1st April 1888, there are seven Sub-Engineers and one Temporary of the 1st grade. Looking down this list, and examining the services of $\frac{3}{4}$ ths of the number, and comparing them with those in the 2nd and 3rd grade, the question must arise—What blocks the promotion? The answer is, the separation of the Irrigation from the General Branch in 1869. The majority of the former being juniors in the service received rapid promotion in that Branch, and then, by the amalgamation of the two Branches, these juniors came back to the higher grades—viz., Fox, Morrow, Fouracres, Bama Churn Paramanic.

		Yrs.	Mths.		Yrs.	Mths.
Take the 1st named	...	19	3	service	17	1
" 2nd "	...	19	3	"	14	1
" 3rd "	...	19	3	"	14	1
" 4th "	...	24	5	"	5	7

Take two more, Bartlett and Surrnth C. Ghose.

		Yrs.	Mths.		Yrs.	Mths.
1st named	...	18	9	service	8	0
2nd "	...	25	11	"	15	7

Why have the above superseded P. C. Banerjee and others of the 2nd grade, and even the 3rd grade? I leave to others more conversant with such matters to state how men with 19 years and 3 months' service obtained promotion so early to the 1st grade. I can only account for this rapid promotion by the fact, that three were taken on from the Canal Company, that another was sent to Burma as an Assistant Engineer, and finding the place too hot, came back to the grade of Sub-Engineer; and that two have superseded their seniors by luck. This disposes of $\frac{3}{4}$ ths of the 1st grade. How then can it be expected that men with 32, 29, 28, 27, 25 years' service in the 2nd and 3rd grades ever hope to draw even the

minimum pension of the 1st grade before they reach the barrier of 55 years of age, unless they are lucky enough through the kindness of the Bengal Government to be kept on for a longer period?

Then why should any officer of the Department be allowed to go on Foreign Service out of the P. W. D.? Take for instance Mr. Fouracres; there is to his credit 4 years and 10 months Foreign Service in the Calcutta Municipality. He came back and was posted to the Department, obtained the Rs. 100 after 10 years in the 1st grade, and immediately applied for furlough on half pay for two years to take up work with a private firm on Rs. 700 per month, and will return on the 2nd September next. Here is a Subordinate away from the Department for a period of six years and ten months with 19-3 service and 14-1 in the 1st grade, with the maximum pension when he retires, viz., Rs. 250, while others who have tried their very best to get on have been baulked.

I shall now close with the following remarks. The Subordinates of the upper grades will with me, I feel perfectly sure, thank His Honor the Lieutenant-Governor of Bengal for rewarding the long and meritorious service of a subordinate, and it is only hoped His Honor will extend the same consideration to others equally deserving. But His Honor cannot be aware that in rewarding the meritorious service of one officer he at the same time is inflicting a punishment on a number of deserving officers of the upper grade of Subordinates who anxiously look forward to promotion on an officer's retirement at the age of 55 years.

Is it not possible for the Government of Bengal to recommend that after a Subordinate attains the age of 55 years his name should be removed from the General List and placed on a Surplus Establishment similar to those in the Railway Branch. This could be easily done, if it is the desire of the Government of Bengal to reward its old servants with an extension of service until such time as reported unfit for further service, which I am glad to say my friend P. C. Banerjee is not, nor will, it is to be hoped, for years to come.

A EUROPEAN SUB.

May 26, 1888.

IRRIGATION PROJECT MANIA.

SIR,—Since Sir Arthur Cotton's scheme for improving the irrigation of the Godavari, this Presidency has from time to time been startled with projects by would-be Cottons. We have had over twenty since the above-named Engineer left India for improving the irrigation of the Presidency. Some have been commenced and stopped for want of funds; others shelved for the same reason, or on account of a change in the Chief. In writing on the above, it is not with any intention to throw cold water on aspiring Cottons, but to hint on the necessity of Government being a little more prudent than they have hitherto been with public cash. By all means encourage officers prosecuting schemes for improving the welfare of the people. This I consider a duty on the part of Government, but before spending a lot of money, have a thorough investigation, so as to be certain that public money is not needlessly thrown away. Several schemes have been started and stopped for want of funds; this is so much money needlessly thrown away.

The would-be Cottons support their proposed schemes with glowing reports and any amount of figures, by which they shew, and honestly believe themselves, that the proposed project will, after paying all expenses, including interest on capital laid out, yield a nett profit of so much, and that so many thousand acres of waste land will be brought under wet cultivation, &c. Reports of this kind are all very well on paper, but are seldom, or never, borne out by facts. Take the most favorable scheme that was ever carried out, viz., the Madras Water and Irrigation Scheme.

Here we have a large reservoir, with a reserve one in the Choleaveram Tank, the local drainage of the two (Red Hills and Choleaveram) being over 60 square miles, with the command of a river that is flowing throughout the year, thousands of acres of land to be cultivated, being near Madras, and manual labor cheap and plentiful. If any scheme paid itself surely one under the above circumstances should do. Let us look at facts. Before this scheme was started, it was stated that besides providing Madras with water there would be sufficient to irrigate 8,571 acres of land, which at Rs. 7 per acre would yield Rs. 60,000 per annum; beside that derived by sale of water to the Municipality. How this statement has proved true will be seen from the report for 1879-1880 on the above scheme, which shews that although several acres yielded two crops, the total revenue from irrigation did not exceed Rs. 18,000, and the amount derived from the Municipality was between Rs. 3,000 and Rs. 3,600. Taking the latter amount, the total revenue from all sources for 1879-80 did not exceed Rs. 21,000.

The cost of the scheme up to 1885 is about 22 lakhs of rupees, and the revenue derived, as stated above, would not pay more than $\frac{1}{2}$ per cent. interest, and, if the cost for conservancy and collecting be deducted, much less.

Supposing this 22 lakhs borrowed at 5 per cent., the annual loss to Government is about Rs. 77,000. The money spent on the above scheme may be considered well spent, as it supplies the largest town in the Presidency with water, but it does not alter the question of saddling the country with debt. When a scheme

under the most favorable circumstances as it is possible to imagine turns out a myth so far as increase of revenue, what will those proposed schemes under less favorable circumstances, if ever carried out, prove will be for the coming generation to know.

Some 20 years ago I remember a scheme was proposed to throw a dam between two hills through which a river flowed, and by means of channels on either side bring some thousands of acres of waste land under wet cultivation. The scheme was a very simple one, and would not have cost much, but was knocked on the head by, I think, Captain Ryves, who was then Superintending Engineer, on the ground that when the project was completed, where were the ryots to be got to cultivate the wet lands? Those words of Captain Ryves might be used with reference to the Periyar project, "where are the ryots to come from?" Anyone who knows the Madras ryots, knows that they are like cats, fond of their homes, from which they will not go unless driven by famine; also that they are very particular about water and climate. It is a well known fact that about Periyar there is nothing but jungle, and the climate for a part of the year very unhealthy; besides the place is infested with wild animals, especially elephants. Is it likely that ryots will leave their homes to live in a malarious climate and cultivate land to fatten wild elephants?

The next question, and the most important, is of finance. Can India spare the cash for this gigantic scheme? If she can, I would recommend that she put what irrigation works she has in order, from which there will certainly be large returns.

Estimates for lakhs of rupees have been sanctioned for repairing old irrigation works, but owing to want of funds are not being prosecuted.

PRUDENCE.

ESTIMATING THE HORSE-POWER OF STEAM BOILERS.

SIR,—Whilst thanking Mr. C. L. Phillips for the consideration he gave to my query, I need draw his attention, or anybody else's of those interested in these points, to the fact that the subject gone into is not on the ground of Engineering considerations but on the one of management.

Of course, as he implies, any *Engineer* will call grate area that much on which combustion proper goes on; that the dead-plate is not such area is needless to say.

On the other hand, a boiler's H.-P. will ever remain an indeterminable value unless it be in a way with a great deal of margin either side.

The rule according to which the Calcutta Commissioners determine the fees to be paid for inspection is well understood to be an arbitrary one, simply calculated to levy certain fees to cover expenses, approximately in proportion to size of boilers, whether the H.-P. so arrived at is, or is not, in correspondence with a standard of mechanical energy.

No doubt something like a H.-P. is mentioned by the Commissioners; but there is no use whatever in that; they practically charge the mill-owners according to a certain number of superficial square feet of grate area, and have set down seven classes of boiler sizes, with seven different rates up to Rs. 50, after which whatever be the H.-P. or size, no higher rate is charged.

The formula, scale of fees, etc., are not questioned; but the correct application of those in every day's practice is.

It has happened to me that some of our boilers have been classed too high: has that happened to anybody else, and if so, how was the case settled?

Or perhaps, as the fees are this year less than last year's ones, nobody cared to check how far their boilers were classified in accordance with the new rules.

Perhaps also I would have done the same, had not my attention been called to the matter by two large boilers by the same maker (Galloway), set side by side, identical in size, description, in fact, in every respect, being classed one as 76 H.-P., the other as 42 H.-P. In other words, two boilers of exactly the same dimensions were classed one 22 H.-P. in excess, and the other 12 H.-P. less than the formula provided for, notwithstanding this last being so set as to leave no room for ambiguity when kept to strictly. Indeed there seems to be no rule at all followed.

Some other boilers of ours have been classified in accordance with the rule, and without including the dead-plate, for had the dead-plate been included, they would have belonged to the next higher grade than they were set in.

This case has been a much discussed and contested one, necessitating a considerable amount of official correspondence, without bringing forth anything more to the point to explain or remove the anomaly than "it is because it is so."

At present my position is, that in one of our factories the boilers of nearly the same cubic contents as the other ones of the other factory, but having a different grate area, are set down as 36 H.-P. through leaving out the dead-plate, and so are in the third-class of rates, namely, Rs. 25; whereas if the dead-plate be included they would be in the fourth-class, that is Rs. 30.

In the other factory some boilers are set down as 64 H.-P. through including the dead-plate, which, if left out, as in the above case, would become 54 H.-P., and be in the fourth-class of rate (Rs. 30); but they have been set in the 5th class (Rs. 35).

The difference in point of fees paid is not much, and would not

be worth the trouble, were it not that one has to be careful of interests entrusted to him.

But what is not to be passed over so easily is the attempt of covering a first mistake by making somebody else bear the consequences of it, and clapping on H.-P. so as to come up to the original total fees, and even a little over it.

I was made to understand that I must pay that fee and be satisfied with the decision arrived at by "one."

I am much mistaken if this is not an attempt at "rough shod riding" over people.

I do not think that I or anybody else should be so easily satisfied (besides paying extra for it) and stand passively such proceeding.

Neither do I believe that any of the Commissioners could uphold such proceeding, and I must appeal against it to higher authorities than that "one."

So I need previously seek as much information as may be obtained through Engineering papers from mill-owners or steam-owners.

This is so much the more required as such case is not at all considered in the whole of the regulations, but only those appeals of owners against repairs or alterations considered necessary for safe working have been provided for.

G. DUBERN.

CALCUTTA ICE ASSOCIATION ; }
May 23, 1888. }

JEYPUR GAS WORKS.

SIR,—Your editorial reviewing my annual report, the correct view you take in giving the Jeypore rulers their well-deserved praise, and your advice to Municipalities and others concerned to study such reports, affords me the occasion to give you further information on the practicability of *Oil Gas* for India, which might be of interest.

In England, where coals are abundant and cheap, and where large funds are invested in Coal Gas Companies, no great attempts had ever been made to employ oil gas, even where it would have been of advantage. On the Continent, where coals cannot be had at such low rates as in England, more practical use is made of oil gas; and as far as India is concerned, excepting a few sea-shore towns, and such cities as have coal-mines within a short distance, I think oil gas will favorably compete with any other light.

Oil gas is best known as Pintel's gas, and much controversy had been going on lately as to the best mode of manufacturing this gas. No end of patents had been claimed, which have, I don't doubt, all very well answered in the Laboratory, but very few would stand a practical test. There are but few Engineers with a practical knowledge of oil gas. As this industry is by itself not very old, and as most of the works are but small, it gives little chance to good Engineers to gain a real practical knowledge. The greatest mistake almost all theoretical men had been making was that they should generate this gas by a low heat. To make the best and most gas out of any oil or fatty substance it is not only necessary that retorts are almost white red hot, but it is also most necessary that the flame shall with a free draft of the oven beat constantly against the retorts.

This gas can be generated from any fatty substance, and is generated on the Continent from all kinds of dirty refuse oils which are of little commercial value. I know large wool washes in Germany, where the fatty substance washed off the wool is collected and used for generating oil gas. Others collect the dirty grease of Railway axle carriages, and cotton waste saturated with oil from large workshops, to generate gas from; crude naphtha, petroleum and the refuse oils from petroleum refineries are a most valuable material for generating oil gas, and are by far preferable to any vegetable or heavy animal oils and fatty substances.

For India, where for the transport of material long and heavy Railway expenses have to be incurred to up-country towns, the oil gas is the only one which can be used with advantage, for reasons which I shall try to explain in the following:—

1st.—The oil gas is much more powerful than coal gas, and is when compared with the latter as 1 to $2\frac{1}{2}$, that is, an oil gas jet consuming one cubic foot gas has the same lighting power as a coal gas jet consuming $2\frac{1}{2}$ cubic feet.

Consequently the whole plant, as apparatus, gasometer and pipes are required to be in this proportion only, viz., as 1 to $2\frac{1}{2}$; consequently the cost of outlay for the plant is comparatively much smaller.

2nd.—The oils give a much larger quantity of gas than coals; from one ton petroleum or petroleum refuse the average gas generated is 32,000 cubic feet, whereas the outturn of best Indian coals is hardly more than 15,000 cubic feet. Taking in account that the 32,000 cubic feet oil gas generated from the one ton of oil will have a lighting-power of 80,000 cubic feet coal gas, it is required that six tons of coal be used and Railway freight paid for to obtain the same light from one ton of oil.

3rd.—Oil gas containing less impurities than coal gas, does not require much purifying, and the process being simple, it is therefore the only gas that could be advantageously employed in small works, as for lighting single residences, hospitals, military barracks, Railway stations and factories, &c. Any intelligent native fitter will be able to carry on

a small work of this kind after receiving a short practical instruction.

For lighting up Railway carriages and bays in river beds no other gas but oil gas can be used, as this is the only gas which can be compressed.

As a professional, I always made more than casual observations wherever artificial light is concerned, and I never could understand why Indian Railway Companies never yet attempted to supersede their present primitive mode of lighting Railway cars. In no country in the world are longer Railway journeys made than in India, and I think everyone feels the want of a good light on long journeys. If oil gas were in any way more costly, it would then be easily understood why the comfort of the public is not taken into consideration; but as the lighting of Railway carriages by oil gas would come cheaper than the present lights, it must be known to Indian Railway Companies only why they stick to the present mode of lighting, which is just the same primitive light as was used at the time when Railways were invented.

Lately I had been consulted by an Indian Railway Company about lighting Railway carriages with gas. According to my estimates the cost of lighting one lamp would be 2½ annas per diem of ten hours inclusive of all charges, interest on capital for plant and carriage fittings, pay of establishment, maintenance and cost of material. I think this should favorably compete with oil lamps, not considering the greater lighting power and comfort to the travelling public at all.

At present the cheapest oil for this purpose to be used in India is American and Russian kerosine oil. The crude oil or the residuals from crude oil refineries would be by far better for the purpose, but as the demand is small in India, this, although available for much less than half the price of the purified oil, would cost, under present circumstances, much more than the refined kerosine oil, as higher freights would be charged for it on steamers and Railways than for the pure oil. Very likely when once the advantage of this gas for India will be more appreciated, larger quantities will be required, so that separate steamers could be chartered for it and Railway Companies could be induced to build separate trucks for carrying these oils as they do in Europe and America, at a cheaper rate. We might then have a cheaper material for this purpose. And should the Government of India once open the oil-fields of this country, or companies concerned in Burmese oil wells better study their interests than they do now, we might have then a cheaper material for generating this gas.

S. J. TELLERY,

Supdt., Gas Works, Jeypore.

May 22, 1888.

THICKNESS OF WATER PIPES UNDER PRESSURE.

SIR,—Some years ago I had occasion to go into the question of the thickness required in water pipes under pressure, and what follows is the result of that investigation.

The theoretical formula for arriving at the necessary thickness for cast-iron pipes is: $t = \frac{P \cdot R}{c - R}$, where t = thickness of pipe in inches,

R = inside radius in inches, P = working pressure in lbs. per square inch, c = tensile strength of cast-iron in lbs. per square inch.

It is obvious that for practical purposes the R below the line may be left out, then $t = \frac{P \cdot R}{c}$.

The value of c ranges from 14,000 to 16,000 lbs. In practice it is usual to fix upon some factor of safety whereby c is divided. Some Engineers then add a constant to the calculated thicknesses of the pipes, in order to resist the shocks they are liable to. The factor ranges from 4 to 10, the constant from 0 to '60".

The pressure of water is taken by most authorities to equal '433 H, where H = the weight of the column of water to be supported.

(a.)—Molesworth (Pocketbook, p. 209., ed. 1880) gives:

$$\begin{aligned} t &= '000054 H d + x, \\ &= '000125 P d + x, \\ &= '000250 P \cdot R + '60", \&c., \\ &= \frac{P \cdot R}{4,000} + '60", \&c. \end{aligned}$$

where d = diameter of pipe in inches = $2 R$, and x = constant to be added.

He takes $c = 16,000$ lbs., his factor of safety is 4, and his constant is '60" for pipes from 50" to 30" in diameter

50 " 30" to 12" "

37 " less than 12" "

His factor is, therefore, small and his constant large.

(b.)—Gale (Glasgow Water-Works) also takes $c = 16,000$, but his factor of safety is twice as large as (a), being 8. He says that the constant to be added to this depends entirely on circumstances, and that his practice is to increase his large pipes $\frac{1}{4}$ " at a time.

Applying, however, the formula $x = \frac{P \cdot R}{2,000} - t$ to the table published in Molesworth (p. 210), we find that his constant is '25" if we take the nearest $\frac{1}{4}$ " for pipes over 20" in diameter, the nearest $\frac{1}{8}$ "

for pipes over 18" in diameter, the nearest $\frac{1}{4}$ " for pipes over 5" in diameter, and taking the highest numbers for choice.

Gale's formula is therefore: $t = '00500 P \cdot R + '25"$.

$$\begin{aligned} &\frac{P \cdot R}{2,000} + '25". \end{aligned}$$

(c.)—Armstrong (Elswick Factory). Here, I believe, the formula in use is: $t = '00446 P \cdot R + '40"$

$$\begin{aligned} &\frac{P \cdot R}{2,240} + '40". \end{aligned}$$

With $c = 16,000$ the factor of safety is a little over 7 and cast-iron is taken as bearing a ton against Gale's 2,000 lbs., but a heavier constant is added. This formula is the result of extensive experiments made on cast-iron pipes and cylinders.

(d.)—Spon (Dict. of Eng. Art., Pipes, p. 26—55) gives the formula $t = \frac{P \cdot R}{c}$, where $c = 15,000$ and the factor of safety 10. His formula is therefore equivalent to $t = '000667 P \cdot R$,

$$\begin{aligned} &\frac{P \cdot R}{1,500} \end{aligned}$$

This is stronger than anything we have come to as yet; but then he adds no constant for shocks, &c. He quotes Molesworth as given above and shews that, with a 10" pipe, there is not much difference between the methods.

(e.)—French. Spon then proceeds to give the formula used in Paris and in other large French towns as: $t = '0016nd + '008m$, where t and d = thickness and diameter in metres, n = "effective" pressure in atmospheres per square metre.

To reduce this to our English form $t = '000218 P \cdot R + '315"$,

$$\begin{aligned} &\frac{P \cdot R}{4,569} + '315". \end{aligned}$$

This gives a lighter pipe than would be considered safe here; the factor of safety being only 3½, and the constant added smaller than Armstrong's, whose factor is 7.

(f.)—French. Taking, however, the "effective" pressure to mean the proof pressure or twice the working pressure, we get:

$$\begin{aligned} t &= '00436 P \cdot R + '315", \\ &= \frac{P \cdot R}{2,284} + '315", \end{aligned}$$

which is singularly near (b) and (c).

(g.)—Humber (on the Water-supply of Cities and Towns, p. 189 ed. 1876) quotes Molesworth as given above, and a formula of Mr. Hawksley is also mentioned. This is: $t = '18 \sqrt{d}$; but as this method ignores any difference due to different pressures it is not, I believe, generally used.

(h.)—Humber takes the formula $t = \frac{P \cdot R}{15,000 - R}$ and adds that it is often necessary to make pipes of thicker metal than this, which is true enough.

i.—Latham. At page 295 of Humber's work is given a table of Mr. Latham's pipes. By applying to this table $c = \frac{P \cdot R}{t}$, I find that the formula used is $t = '000669 P \cdot R$

$$\begin{aligned} &\frac{P \cdot R}{1,495} \end{aligned}$$

or practically the same as (d).

k.—Rankine gives the formula: $\frac{\text{thickness}}{\text{diameter}} = \frac{\text{head of water}}{12,000}$, with $c = 16,000$. The factor of safety, in this case is 6, and pipes made according to this method would be strong enough, were it not for the sudden shocks they are liable to and for which the formula makes no provision, it being $t = '0003845 P \cdot R$

$$\begin{aligned} &\frac{P \cdot R}{2,601} \end{aligned}$$

Abstract.

$$(a.)\text{—Molesworth } t = '000250 P \cdot R + '60" \&c., = \frac{P \cdot R}{4,000} + '60".$$

$$(b.)\text{—Gale } = '000500 P \cdot R + '25" = \frac{P \cdot R}{2,000} + '25".$$

$$(c.)\text{—Armstrong } = '000446 P \cdot R + '40" = \frac{P \cdot R}{2,240} + '40".$$

$$(d.)\text{—Spon } = '000667 P \cdot R = \frac{P \cdot R}{1,500}$$

$$(e.)\text{—French } = '000218 P \cdot R + '315" = \frac{P \cdot R}{4,569} + '315".$$

$$(f.)\text{—ditto } = '000436 P \cdot R + '315" = \frac{P \cdot R}{2,284} + '315".$$

$$(i.)\text{—Latham } = '000669 P \cdot R = \frac{P \cdot R}{1,495}$$

$$(k.)\text{—Rankine } = '000384 P \cdot R = \frac{P \cdot R}{2,601}$$

ERNEST BENEDICT,

M. Inst. C.E

KARWI, N. W. P.;
May 24, 1888.

General Articles.

THE BETWA CANAL, NORTH-WEST PROVINCES. PRELIMINARY ENQUIRIES AND OPINIONS.

A SELECTION from the Records of the Government of India on the Betwa Canal Project just issued is rather voluminous, but then likewise it is exhaustive, and embodies the views and opinions of a great number of Revenue and Canal authorities on the subject of Irrigation. The Betwa Canal has a history of its own. Its salient features may be thus epitomized.

The first proposal for the construction of a canal from the Betwa was made by Major-General (then Captain) Strachey, dated November 1855. An establishment provided to investigate the subject perished in the Mutiny. In 1859 the question was again considered, but nothing was done until the end of 1867, when Lieutenant Home, R.E., was directed to conduct the enquiry: and accordingly, in 1867-68, the country was examined with a view to ascertain its capabilities for the projection of canals.

In August 1868, Lieutenant Home submitted a preliminary report which established that it is practicable to utilize the waters of the Betwa River for irrigating the tract enclosed by the three rivers—Jumna, Pahooj and Betwa. Therefore, further and more complete investigations were ordered, and in September 1868, definite instructions for prosecuting the enquiry during the ensuing season were sent to Lieutenant Bagge, R.E., who had in the meanwhile relieved Lieutenant Home.

Before leaving India Lieutenant Home sent in a more detailed project for a Betwa Canal. The cost was estimated at Rs. 19,29,246, the income at Rs. 1,52,500, or 7·9 per cent.

Mr. Anderson, Superintending Engineer, was now deputed to examine the projected alignment of the Betwa Canal. The conclusions he came to were—

I. That Pareecha, the site fixed by Lieutenant Home, is the best position for a weir.

II. That for four or five months of the year 1,000 cubic feet of water could be depended on, even in years of deficient rainfall.

III. That further investigation was needed, however, before the alignments could be definitely fixed; and that until this was settled work should not be begun.

The Chief Engineer agreed to these conclusions, and decided that the head of the new canal should be fixed at Pareecha.

In November 1869, Lieutenant Bagge, R.E., submitted a detailed project and estimate for the Betwa Canal, including provision of storage for water in the bed of the river with a view to perennial irrigation. But the amount of the estimate, 90 lakhs, was prohibitive; and as Lieutenant Bagge was obliged from ill-health to go to England, where he died, and as Mr. Anderson's services ceased to be available on account of his employment in supervising the construction of the Agra Canal, the question of the Betwa Canal was shelved until April 1872, when, after the country had been visited by Sir W. Muir and the Chief Engineer, the approval of the Government of India was solicited to the preparation of detailed estimates of a scheme limited to affording irrigation for rubbee and monsoon khureef, and excluding mar soil from present consideration.

In June 1872, the Government of India sanctioned the preparation of detailed estimates; but desired that the eventual irrigation of mar soil should be contemplated in designing the works; and that a full discussion of the question of returns should at the same time be gone into.

After all the weir was finally built at the Khurd site and the canal was opened in September 1885.

The Betwa Canal Project is remarkable for the height and length of the weir in the river to raise and force the water into the canal. It is moreover an instance of providing irrigation under the most adverse financial conditions. We have here a weir with a very dubious, erratic water-supply, and a country requiring extremely

costly works: (a) to obtain the command of land; (b) to get over excess fall; and (c) to give adequate provision for drainages.

The State paper we have under review contains also several interesting discussions as to the probable effect on the agricultural system of the Betwa Doab of the introduction of canal irrigation. The plans are the poorest part of the selection. The best map shows the drainages and the main and minor channels of the canal. Another one gives the reach of the weir at the head of the canal on a large scale. The physical geography of the Betwa Doab is detailed in the following extract:—

The triangular space extending from latitude 25° 42' 30" N. to the River Jumna, bounded on the east by the Pahooj, on the west by the Betwa—its affluents—and embracing an area of some 1,500 square miles, forms the irrigation field of the proposed Betwa Canal. Higher up the Doab, the country presents generally an undulating surface, alternating in hills and valleys, broken here and there by quartz dykes, and huge disintegrating masses of granite and its associate rocks.

The proximity of these rocks to the surface, and the irregularity of the elevations, which possess no natural connected form of anticlinal axis, together with the rapid outfall of the country, present formidable obstacles to the construction of a large canal from a much higher point on the Betwa River than that now selected; and this is further prevented by the necessity of having to fall back upon the bed of the Betwa itself as the only available storage-basin for the proposed canal in seasons of extreme drought.

The different soils can be brought under four principal heads:—

- | | | | |
|-----|-------|-----|---|
| (1) | Mar | ... | Black soil. |
| (2) | Kabar | ... | Rich loam. |
| (3) | Purwa | ... | Sandy soil. |
| (4) | Rakur | ... | Coarse sandy soil; sometimes containing nodules of kunkur, at others masses of quartz, gravel-beds, &c. |

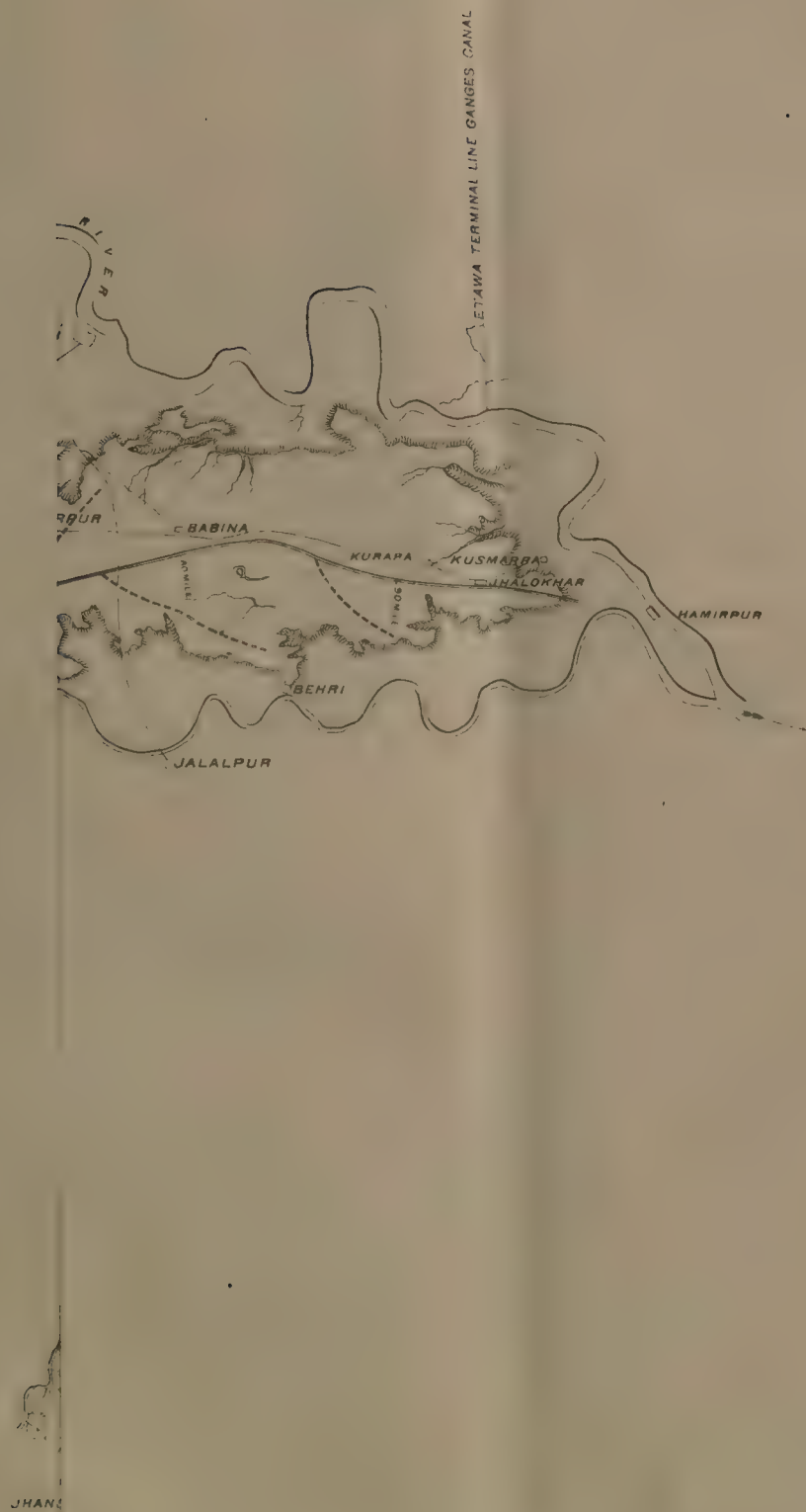
Out of the 528,000 cultivated acres, 300,000 acres may be said to be "mar" soil; it is black, friable, very retentive, expands greatly under moisture, contracts as it parts with it, leaving a surface cut up by a network of fissures, fertile without irrigation.

A minute by Sir W. Muir, K.C.S.I., Lieutenant-Governor of the North-Western Provinces, gives an idea as to how where the rainfall is precarious and uncertain the value of land as an investment depends upon Irrigation Works.

He says:—I know few parts of the country (the Bhuttiana territory perhaps excepted) for which canal irrigation would prove a greater blessing than the area which would be open to these canals. In the Jaloun District, the water is at immense depths, and wells consequently are sunk and worked at an expense prohibitive, as a rule, for irrigational purposes.

Any failure in the monsoon is therefore felt with peculiar severity in this tract. The rainfall is generally more scanty, irregular, and uncertain, than in the Doab and the Trans-Gangetic Provinces. At the approach of drought, the people are in the habit of emigrating for the time to more favored quarters. The tenure of land is consequently far less valuable and fixed than where the production is tolerably certain. There is less accumulation of capital and less ability to tide over seasons of difficulty. And so, when drought and famine do come, the miseries of want and depopulation are experienced with an intensity and duration quite unknown in the more favored tracts to the north of the Jumna and Ganges. It takes years often for a famine-stricken tract to recover itself.

On these grounds I should not be inclined to favor any project that did not include an ample rubbee supply. It is true that there are great stretches of the fine black soil (locally called *mar*), which have an extraordinary



retentive character; so much so, that one finds the rubbee crops often green and flourishing in February, though not a drop of rain may have fallen for five months previously, if the rains were good during the monsoon. On the same grounds it might be urged that a plentiful watering in September or October would impart sufficient moisture to produce good rubbee crops. But in the first place, the above remarks refer only to the finer mar soils, and not to the others (kabar, purwa, and rakur) of which the *purwa* (a light soil with admixture of sand) is especially well fitted for irrigation; next, the effect of irrigating the black soils during the rains or immediately after is uncertain; when wet they form into a miry, sludgy mass, and which might be difficult to work; and lastly, it is doubtful, apart from the last mentioned result, whether the people would be ready to take water in the khureef, excepting under pressure of extreme drought. Then no doubt, as in the present season, water would be eagerly sought; but I should be unwilling to support the project of a canal likely to be useful only in seasons of drought, unless it were shewn to be absolutely impossible to construct one that should answer also for the spring crops of ordinary seasons.

Experience in other rainless tracts shews that a permanent full rubbee supply is by no means a necessity. A failure may cause a partial loss, more often a poor crop, rarely a total loss. It goes without saying, however, that the Canal Officer would naturally, however, prefer the certainties and ease of a constant supply.

The Settlement Officer of Jaloun, in his note, dated June 1874, makes the following pertinent remarks on the value of even an uncertain and variable supply of canal water:—

The Secretary of State's despatch of 23rd April last, paragraph 2, noting that the Betwa Canal project is said to be intended mainly as a safeguard against famine in exceptionally bad years, doubts if in such years of scanty rainfall there would be rain enough to fill the canal. But local drought, the evil to be conquered, would not disable the canal. The Betwa rises in latitude $23^{\circ} 14'$, longitude $77^{\circ} 22'$, about two miles south of a large lake near the town of Bhopal, and runs a course of 360 miles before its junction with the Jumna at Hamirpur, adjoining our district; about half of this total length is outside the province of Bundelkhand. In all the extensive tract of country simultaneous drought is extremely improbable. For all but the most extraordinary calamity, therefore, the Betwa for us is likely to be filled with the periodical rains, and the canal to serve its purpose of saving our produce even in seasons that locally may be exceptionally bad.

Again, as regards the local rainfall, our unfavorable seasons are oft times owing to a great burst of the monsoons in the beginning, and then either an unduly long dry interval, or an unequal distribution of the remaining rains. The canal would be at hand to prevent the loss of crop, and the consequent hardship to the agriculturist more frequently occurring through these common causes.

Another signal benefit that must accrue from the canal is the absolute security it will give to the sowing of the rubbee. In the great majority of cases our bad rubbee harvests are due to the failure of the latter rains. The rainfall may shew no deficiency in the tally of inches usually denoting a full supply; yet it may be that the September and October showers have been entirely absent or quite insufficient, and if so, the rubbee is jeopardized. Mar might yield some kind of a crop notwithstanding, but the kabar soil, which is nearly 30 per cent. of the whole cultivated area, remains untilled and barren for the season, and is only gradually taken up again. This not uncommon source of danger would be completely nullified by the canal, which must always be brimful of water in those months.

Then as to good years when it is thought that the canal water will run to waste without any call for it during the khureef; this assumes that the present system of agriculture will make no improvement, that the *juar*

and *bajra* millets, which form the food of the poorer classes, and which never will be ordinarily irrigated, will continue the staples of the khureef; together with cotton. I altogether differ from this view. Let water but pass the doors of the people and the irrigable khureef staples, rice, sugarcane, and perhaps indigo (cotton we already have), will speedily come into vogue; they are not now grown simply because it is impossible to grow them without water. Within the last few years subsequent to the settlement, whenever *kutchra* wells could be economically dug they have been constructed, and the sugarcane crop introduced. Although, therefore, the present scheme is said not to contemplate khureef cultivation to any extent, the strong probabilities are that, before long, the force of circumstances, induced by the operation of the most natural motives, will invest it chiefly with the character of a khureef canal, and its utility in the rubbee in almost all years is indisputable.

E. A. S.

DRAINAGE OF TOWNS BY OPEN DRAINS.

By H. W. HUGHES, C.E.

III.

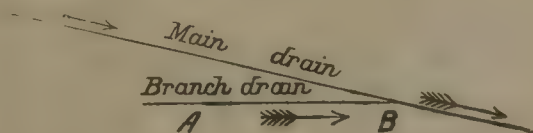
Designing a system of drainage.—We have now noticed briefly what drains carry, the circumstances that should guide the selection of outfalls and the method of separating sewage water from rain water in floods of sufficient volume to ensure its being harmless if admitted into the streams and rivers of the country, and are in a position to consider the details of internal arrangement of drains. It is not proposed to enter into a discussion on the comparative advantages of a system of closed sewers or open drains, it is enough to state, that in nearly every Indian town (except the Presidency towns) open drains have been adopted and are still being constructed, and we may therefore conclude, that they have been found by experience to be the most suitable to this country, and the remarks in the following pages are intended to apply only to open drains.

Under certain circumstances, however, *short* lengths of closed drain are unavoidable and there are few towns where it is not necessary to close portions of a drain either to avoid a deep open cutting in an important street, or to obtain a better line or better level, or for some equally important reason.

In laying out a system of drainage, the drains should be laid along both sides of the streets wherever feasible, so as to ensure a moderate amount passing down each drain and to keep their size within reasonable limits, but if only one is possible, it is generally a good plan to cover it and carry it under the street in the most direct line, particularly if the section of the drain is large.

Special care should be taken in laying down the course of the drains to avoid unnecessary curves and particularly those of short radius.

All minor and house drains should be so arranged as to discharge into the main drain as nearly as possible in the same direction that it flows; as far as can be, this should be done by bringing the branch drain at an acute angle as A B.



It may happen however that a drain cannot be arranged in this manner and the junction has to be effected by means of a curve as C D, and in such cases the fall of the



branch drain in the curved portion C D should be increased.

House drains should not have a less slope than 1 in 20 and they should join the main drain at its bottom level; this arrangement not only allows of a better fall being given to the house drain, but it ensures the discharge from it being efficiently carried away, and avoids the unsightly stains and dirt that are always seen where a minor drain joins much above the level of the bottom of the main drain. One of the most important points as regards open (and indeed *all*) drains is that they should be flushed easily, and the means of flushing and the situation of flushing points should be decided before the lines of drain are finally selected, so that we have three fixed points which must control all other arrangements, viz. :—

1. The outfall.
2. The flushing points.
5. The drains must be arranged so as to keep them of a moderate size, and at the same time maintain a free circulation through all of them—curves being avoided as far as possible.

These are the chief points to be observed as regards general principles, but in actually deciding on a system of drains there are many others that will be found to regulate the relative importance of each of these, for instance the levels of the town will exercise control over nearly every other consideration. House connections will also probably be necessary and there again the relative levels of the streets and houses have to be taken into account, and so on each point has to be well considered in all its aspects separately and the whole scheme then designed to make them harmonize.

The cross-section and slope of the drains must be arranged so that they have sufficient capacity to carry the maximum amount of water in floods, and when only small quantities are passing through them a certain minimum velocity should be maintained.

The section that fills these conditions most nearly is a pointed egg shape. In the Plate annexed will be found sections of from 6" to 24" surface drains, and beyond the latter size it is not advisable to go. Indeed, in crowded parts of the town it is better to have no drain over 15" or 18" wide.

The velocity in these drains should be within the following limits :—

		Maximum	Minimum.
Class I.	... 6" drain	6 feet	3 feet
Class II.	... 9" drain	5½ "	3 "
Class III.	... 12" drain	5 "	2¾ "
Class IV.	... 15" drain	5 "	2¾ "
all others up to 24"		5 "	2½ "

In calculating the velocity Kutter's formula and coefficients are most convenient, viz. :—

$$v = 100 C \sqrt{r S}$$

where S = fall of surface divided by length.

r = hydraulic mean depth

$$= \frac{\text{area}}{\text{wetted perimeter}}$$

v = mean velocity in feet per second.

C = co-efficient depending on the hydraulic mean depth and the fall.

The following table gives some values of C for falls of 1 in 1,000 and steeper falls.

Description of channel.	Value of r in feet.											
	'1	'2	'3	'4	'5	'6	'7	'10	'20	'25	'30	'40
1. For very smooth plastered channels in cement or for glazed pipes	'84	'104	'114	'123	'131	'135	'138	'149	'165	'170	'174	'180
2. For channels or culverts of cut stone or brick (not new)	'61	'75	'83	'92	'98	'101	'104	'112	'128	'131	'135	'139
3. For rivers or canals with earthen beds in perfect order and regimen					'45		'51	'55	'65	'69	'71	'75

(To be continued.)

NOTES FROM HOME.

(From our own Correspondent.)

NEARLY 80 candidates have presented themselves for the examination now being held by the Surveyors' Institution. It has been found inconvenient to examine this large number on the premises of the Institution, in consequence of which one of the large examination rooms of the Surgeons and Physicians' Hall on the Victoria embankment has been used for the purpose. The candidates include seventeen building and quantity surveyors, thirty-two valuers, and twenty-three land agents. There is a staff of thirty-six examiners (including the most eminent men in the various branches of the profession) and five Queen's Counsel. The examination commenced with out-door work at Osterley Park, where upwards of seventy of the candidates were hospitably entertained by Lord Jersey.

The fifth examination of candidates for the offices of Municipal Engineer and Local Board Surveyor, carried out by the Association of Municipal Engineers, was held last week at the Institution of Civil Engineers. Twenty-three candidates presented themselves for the examination, which lasted two days, the first of which was wholly taken up by the written portion of the examination, the oral portion being taken on the second day. The examiners were—in 1 Engineering as applied to Municipal Work, J. Gordon, Borough Engineer, Leicester, President of the Association; 2 Building Construction, W. G. Laws, City Engineer, Newcastle-on-Tyne, Past President; 3 Sanitary Science, H. P. Boulnois, Borough Engineer, Portsmouth, Vice-President; and 4 Public Health and River Pollution Acts, E. B. Ellice Clark, London, Vice-President, and C. Jones, Ealing, Past President, all of whom are members of the Institution of Civil Engineers.

In Mr. Elington's paper on the Distribution of Hydraulic Power in London, briefly referred to in my last letter, it was stated that the largest use made of the water-power was in the working of lifts. As an indication of the important part which lifts occupied in a modern hotel, it might be mentioned that at the Hotel Métropole, near Charing Cross, one of London's modern hotels, there are, including the two passenger lifts, and that for passengers' luggage, no less than seventeen hydraulic lifts in use day and night, while the work done represented about 2,000 tons lifted 40 feet in this time. Hydraulic cranes are now being extensively used and formed the second largest users of the water-power. The discussion on the paper occupied the last meeting of the Institution. The next papers to be read are descriptive of the Tay Viaduct and of its construction.

The Architectural Association are about to organize an excursion to Ireland. It is intended to visit the Castle and Cathedral at Kilkenny, Kilree, Drogheda, Monasterboice and Mellifont. The remains of the City Walls and other points of interest in Dublin will also be visited.

At the anniversary dinner of the Institution of Mechanical Engineers held to-day at the Criterion, Piccadilly, the Marquis of Hartington is the guest of the evening. At the last dinner of this Institution about three hundred members were present.

The Annual Meeting of the Iron and Steel Institute has been fixed to take place in London on the 9th and 10th of this month, and that of the Municipal Engineers also to be held in London in the second week in July.

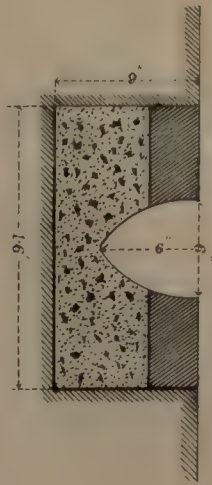
The next paper to be read at the Society of Engineers is Filtration by Machinery, by Mr. Perrett. This paper deals with water filters principally and does not describe filter presses for the extraction of liquid from materials containing an excess of solid matter.

The death is recorded of another of England's best-known Civil Engineers, Thomas Russell Crampton, who was born in 1816. He served under the elder Brunel and Sir Daniel Gooch,

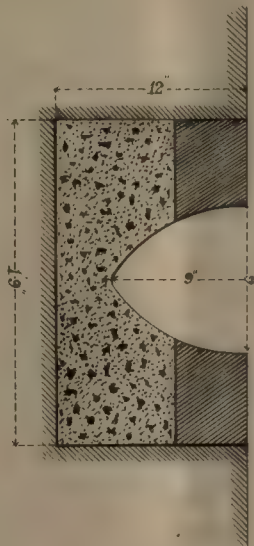
SECTIONS OF DRAINS.

Scale 1 foot to 1 inch.

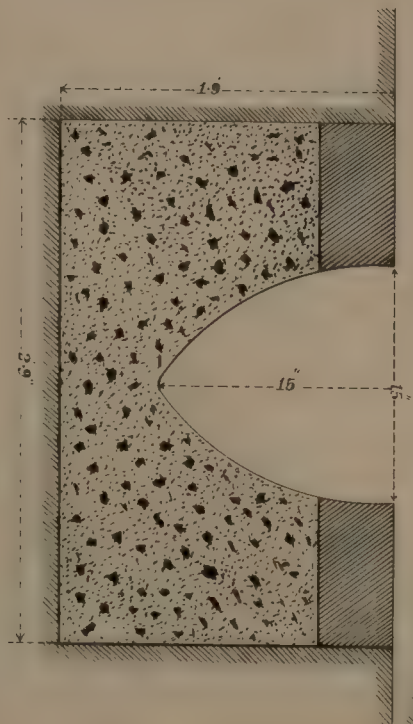
Class I 6 inch



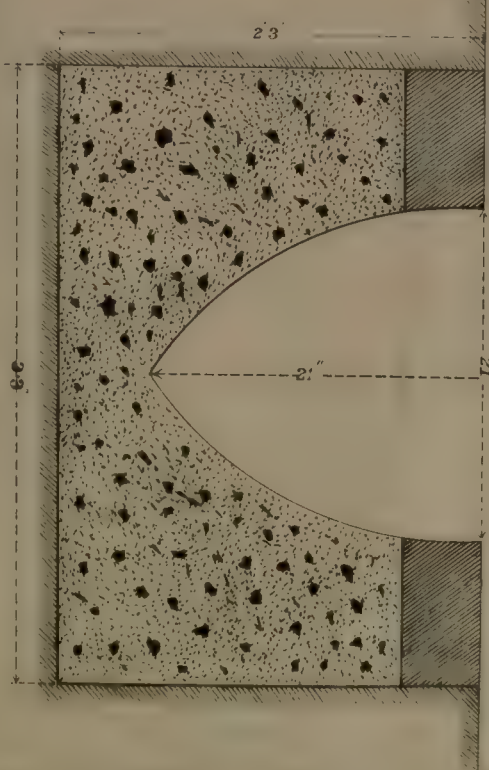
Class II 9 inch



Class IV 15 inch

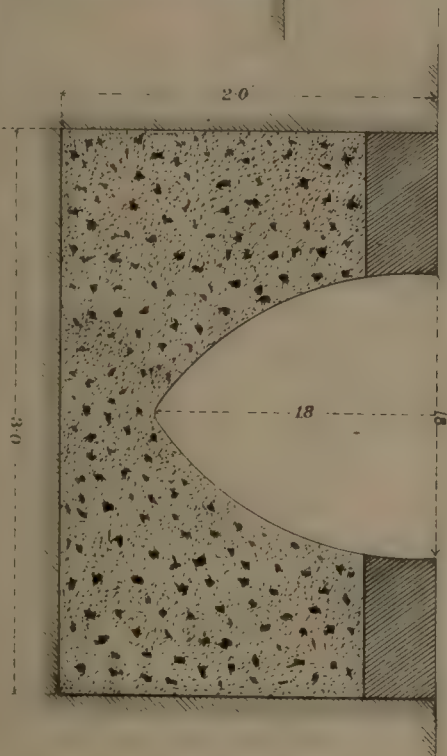


Class VI 21 inch

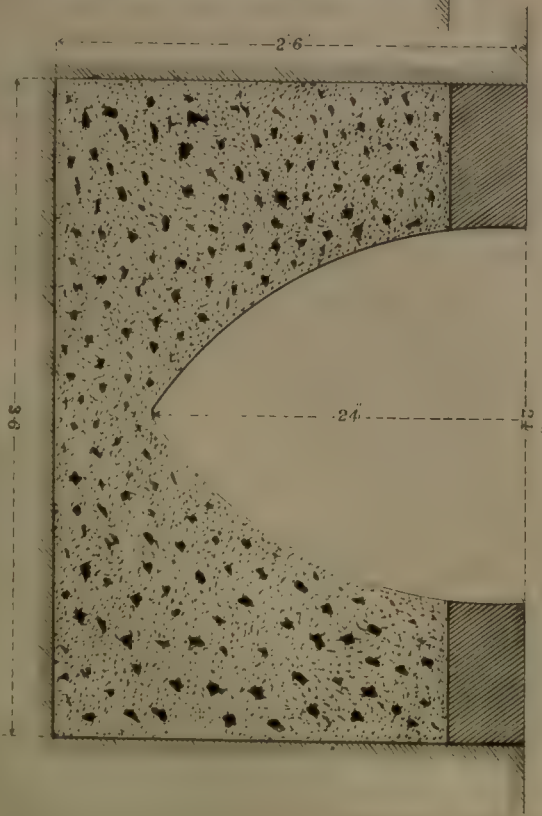


DRAINAGE OF TOWNS.

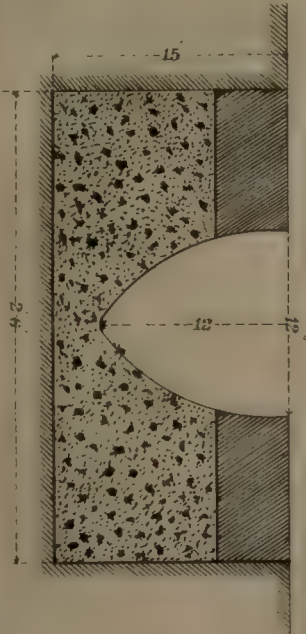
Class V 18 inch



Class VII 24 inch



Class III 12 inch



and under whose direction he designed the first locomotive for the Great Western Railway. Mr. Crampton also succeeded in laying the first cable between Dover and Calais. He took an active part in the controversy of the broad *versus* the narrow gauge; his many works that he has been engaged in, and his many contributions to Engineering literature, place his name in the front rank of the profession.

At a meeting of the Society of Arts recently held, Sir Howard Grubb read a paper on Telescopes for Stellar Photography, his object being to discuss and describe a few of the more important mechanical details of the instruments which are to be used for the international survey of the heavens. The paper is printed in the last number of the Society's Journal.

Mr. Nordenfeldt has an electric torpedo boat of an entirely novel character constructed at the works at Erith. The greatest secrecy is maintained as to the details of the vessel, but it is understood that the torpedos to be discharged from it will penetrate any torpedo boat yet invented.

A Bill has been introduced to make the Imperial Standard Yard of the United Kingdom the legal standard of length measurement for British India, the object being to facilitate future legislation on the lines of the British Mercantile Marks Act.

NOTES FROM TENNASERIM.

(From our own Correspondent.)

Our monsoons have burst on us, and the place, hitherto unbearably hot, has cooled down now to an appreciable degree. Cholera too has been very rife amongst us for the past month, and some very influential persons have been amongst its victims.

A few years ago water was so scarce during the hot season, that Government had to *bring it down by boats* from the river Attaran, sixteen miles away, and it was truly a pitiable sight to see the poor people flocking to the wharf whenever the boats arrived and jostling each other to get first served. When this want of water was recognised *then*; I think the Municipality are greatly to blame for not remedying matters before this. The Executive Engineer's water scheme for Rs. 1,67,000 is now before the Board, and what they intend doing I cannot say, but I would strongly advise a loan from Government and a start made as soon as possible.

Regarding our Cathedral; I have much pleasure in stating that things are beginning to look up. An architect from some firm of Calcutta has been engaged on Rs. 200 a month, and he brought out with him six first-class bricklayers, and really the latter men are sadly needed in Burma. Those obtainable here are but the refuse of India, men probably who were simply brick carriers to a good *mistree* in India, but come out here as *mistrees* themselves. The architect has started work with the bricks supplied him from a local firm, and is making good progress.

The jetty at the old *Avagye* anchorage is fast approaching completion, and the store room is also progressing fast. It was found necessary to build the river walls of the latter on wells, and these were very successfully sunk to a depth of some feet. These were square wells 5 feet inside measurement I think, built on wooden curbs, and lowered by simply scooping out the earth from below. Lying within the fore-shore some difficulty must have been experienced with the tidal influx, but all seems to have been accomplished successfully. The buildings now will stand on as strong a foundation as possible, and no sinking need be feared. In adopting this well foundation, advantage was taken of the extra width provided to build up buttresses as a further security. This wharf and jetty, when completed, will be used by the steamers now plying between Rangoon and Maulmain, the others will have to moor alongside the main wharf. The weekly steamers had from time immemorial put up at the site of the former wharf, that to this day most of the people ignorant of the change, go there when they wish to embark; and it would therefore be well when the return to the old state of affairs is made, as it will be, on completion of the works now in progress.

We have had a change in the P. W. D. members of the Division. Mr. Foy, Assistant Engineer, in charge of Tavoy Sub-division, has been transferred to Henzada, and Mr. C. F. McLeod sent in his stead. Mr. Dodsworth, whose death you have noticed, was Executive Engineer of the Toungoo Division, and very probably contracted his illness when out on the line. Mr. Sage is now in charge of that Division.

MAULMAIN; May 20, 1888.

DEXTER.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, May 19, 1888.

Lower Burma.

Mr. T. E. Owen, Executive Engineer, 1st grade, Toungoo-Mandalay Extension, Burma State Railway, is granted three months' privilege leave from the forenoon of the 12th May 1888.

Mr. E. L. More, Sub-Overseer, 2nd grade, Pegu Division, has passed, with credit, the Colloquial test in the Burmese language.

With reference to *Burma Gazette* Notification, dated the 16th March 1888, Sub-Conductor J. Watson, Sub-Engineer, made over, and Mr. A. W. T. des A. deCrettes, Executive Engineer, 2nd grade, resumed, charge of the Henzada Division on the afternoon of the 10th May 1888.

Punjab, May 24, 1888.

Babu Kali Krishna Mookerjee, Assistant Engineer, 2nd grade, attached to the Kohat Provincial Division, is allowed three months' leave on private affairs, from such date as he may avail himself of the same.

Bombay, May 24, 1888.

Mr. C. Brereton, Executive Engineer, Dharwar, was in charge of the current duties of the office of the Superintending Engineer, Southern Division, from 24th April to 12th May 1888, both days inclusive.

Mr. W. L. Strange, Assistant Engineer, 1st grade, acted as Executive Engineer, Nasik, from 10th March to 1st April 1888, both days inclusive.

N.-W.-P. and Oudh, May 26, 1888.

Irrigation Branch.

Mr. N. F. Mackenzie, Executive Engineer, 4th grade, temporary rank, Nadrai Aqueduct Division, Lower Ganges Canal, is granted furlough for seventeen months, with effect from the 1st July 1888, or subsequent date.

Buildings and Roads Branch.

Mr. D. W. Aikman, Assistant Engineer, 2nd grade, is transferred from the Benares Executive Division, Provincial Works, to the Fatehpur District as District Engineer, *vice* Mr. Bennett, granted privilege leave.

Central Provinces, May 26, 1888.

Furlough for one year, with the necessary subsidiary leave, is granted to Mr. G. G. White, Executive Engineer, Kanhan Division, with effect from such date as he may be relieved of his duties.

Mr. M. Leslie, Executive Engineer, 3rd grade, and Assistant Secretary to Chief Commissioner, Public Works Department, is transferred to the Kanhan Division. Mr. Leslie made over charge of his duties on the afternoon of the 14th current.

Mr. C. S. R. Palmer, temporary Executive Engineer, 4th grade, on special duty in Chief Engineer's office, is appointed Assistant Secretary to Chief Commissioner, Public Works Department, *vice* Mr. Leslie, Executive Engineer, transferred to the Kanhan Division, or until further orders. Mr. Palmer received charge of his duties in the Secretariat on the afternoon of the 14th current.

India, May 26, 1888.

Military Works Department.

Captain G. C. P. Onslow, R.E., is appointed to the Military Works Department as an Executive Engineer, 4th grade, temporary rank, for Special Defence Works, with effect from the 29th March 1888.

Mr. D. Campbell, Honorary Assistant Engineer, State Railways, is permitted to retire from the service of Government, with effect from the 1st February, 1888.

Babu Sheo Nath, Apprentice Engineer, State Railways, is promoted to Assistant Engineer, 3rd Grade, with effect from the 1st March, 1888.

The services of Major-General C. M. Browne, R.E., Chief Engineer, 2nd class, and Officiating Secretary to the Government of Bengal, Public Works Department, are replaced at the disposal of the Military Department.

The services of Colonel C. S. Thomason, R.E., Superintending Engineer and Secretary to the Agent to the Governor-General in the Public Works Department, Central India, are replaced at the disposal of the Military Department, with effect from the 26th May 1888.

The Governor-General in Council is pleased to make the following appointments:—

Colonel J. P. Steel, R.E., Officiating Chief Engineer and Secretary to the Chief Commissioner, Central Provinces, in the Public Works Department, to be Chief Engineer and Joint Secretary to the Government of the North-Western Provinces and Oudh, in the Public Works Department.

Lieutenant-Colonel W. G. Cumming, R.E., Superintending Engineer and Officiating Secretary to the Chief Commissioner, Burma, in the Public Works Department, to be Chief Engineer and Secretary.

Mr. E. J. Martin, Superintending Engineer, Bengal, to officiate as Chief Engineer and Secretary to Government of Bengal in the Public Works Department, Buildings and Roads Branch.

Mr. H. F. White, Officiating Superintending Engineer and Se-

cretary to the Resident at Hyderabad, to be Superintending Engineer, Burma, to which Province he is now transferred.

Military Works Department.

Lieutenant O. H. Stoebr, R.E., temporary Assistant Engineer, 2nd grade, passed the examination for promotion to 1st grade on the 23rd April, 1888.

Lieutenant H. C. Nanton, R.E., temporary Assistant Engineer, 2nd grade, passed the examination for promotion to 1st grade Assistant Engineer on the 9th May 1888.

Lieutenant J. M. Wade, R.E., Assistant Engineer, passed the Departmental Standard Examination on the 9th May 1888.

Lieutenant J. Dallas, R.E., Assistant Engineer, passed the Departmental Standard Examination on the 9th May 1888.

North Western Railway.

Mr. H. L. Butcher, Assistant Engineer, 1st grade, attached to the North-Western Railway, has been granted twelve months' leave to Europe on medical certificate, with effect from 28th March 1888.

Bengal, May 30, 1888.

Establishment—General.

Mr. W. H. King, Executive Engineer, having reported his arrival at Bombay on the forenoon of the 19th instant, the unexpired portion of his furlough is cancelled.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 14th May 1888.

7 of '88.—Reginald Stanley, of Nuneaton, England, Brick and Tile Manufacturer and Colliery Proprietor.—*For an improved boring machine.*

41 of '88.—Henry Harrison Doty, of London, England, Light Engineer.—*For an improved method of, and apparatus for, generating light and heat from mineral or other oil.*

The 21st May, 1888.

200 of '87.—Rudson Calverly Brown, Indigo Planter, of Bhatowlia, Tirhoot, in the Presidency of Bengal.—*For the production of new dyes of various colours, and for certain methods and processes for producing the said dyes, from the plant named "Justicia Secunda" and other plants of the same species.*

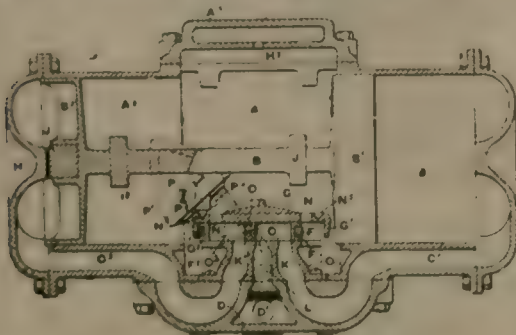
40 of '88.—Daniel Macnee, of No. 2, Westminster Chambers, Victoria Street, in the County of Middlesex, England, Engineer.—*For an improvement in axle-boxes for railway rolling-stock.*

57 of '88.—William Jackson, of Thorn Grove, Mannofield, Aberdeen, North Britain, Gentleman.—*For improvements in machinery or apparatus for rolling tea leaf.*

64 of '88.—Charles Greville Harston, of 219, Beverley Street, Toronto, Ontario, Canada, Captain in the Royal Grenadiers, of Canada.—*For improvements in fire-arms and cartridge magazines therefor.*

RECENT BRITISH PATENTS.

WATER METERS.—M. P. Freeman, Somerville, Massachusetts.—A longitudinal section of the meter, constructed according to this invention, is shewn in the accompanying figure. The shell of the meter is divided into three portions—A A¹ A². The first of these is in connection with the water supply through the opening H², and the latter two are the measuring cylinders. The two pistons B¹ B² are connected by the rod E, on which are fitted the collars J¹ J². The yielding bunters J are sunk into the pistons, in order to minimise the force of the collision between piston and cylinder at the end of each stroke. The valve mechanism consists of the ports K K¹, and of the exhaust port L, which communicates with the delivery pipe D¹. The cover G, with its projecting lips G¹ G², is supported by standards



not shewn; and between G and the valve surface is the slide valve F, which is caused to reciprocate by a rack gearing with the toothed sector shewn in the diagram. The valve F has the two passages O¹ O² in it, and pads are fitted at its ends similar to those on the pistons. The cover G has holes N¹ N² in it, which allow the passage of water through them. The motions of the pistons and the valve are connected

by means of the weighted lever I, which is hinged at the bottom. The head of this lever leans against the collars on the piston rod B, and rocks in the plane of the figure. The action of the parts is as follows: When the position of the mechanism is as shewn in the figure, the water is admitted into A, and passes through the opening N¹ in the cover G, and round the lip G², through the valve opening O², through K¹ C², to the rear of the piston B². The pistons then move to the right, and the liquid which was in A¹ is forced through C¹ K O¹ L, and through the delivery pipe D¹. As the pistons move on the collar, J² comes in contact with the periphery P¹ of the lever I, which is thus swung round its hinge. When the lever has gone a little beyond its central position, some pins which it carries come in contact with the toothed sector; the motion of this sector carries the valve F along with it, and causes it to assume a similar position with respect to the passage K as it did before with the passage K¹. The weight of the lever is then sufficient to cause the collar J¹ to travel on to the right. In order to deaden the blow of the lever I against the cover G, the elastic projections P² are placed on I, and dash pots N² are hollowed out in the cover G to receive them. The action of the meter is then reversed, and the same train of operations re-commences. The inventor makes six claims for this arrangement of weighted lever and the slide valve.—No. 16433. November 29th, 1887.

Advertisements.

P. W. D.

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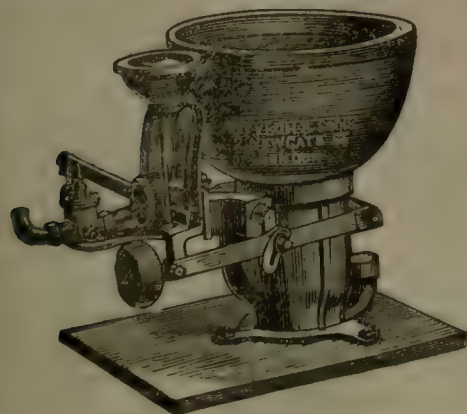
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57-D, Hatton Garden, E.C. (Managing Director of the
Diamond-Cutting Company).

W. CARLTON WOOD, Esq., 41, Basinghall Street, E.C.

EDMOND POWER, Esq. (Messrs REMINGTON & Co.),
Henrietta Street, Covent Garden, W.

BENJAMIN W. FORD, Esq., 38, Leadenhall Street, E.C.

*CHARLES H. STRUTT, Esq., 5, Harrington Gardens,
S.W.

*ROBERT GORDON ORR, Esq. (Messrs. P. ORR &
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* Will join the Board after Allotment.

Commercial Agents in India.—MESSRS. P. ORR & SONS, Madras, Diamond Merchants, Jewellers, and Goldsmiths.

Resident Engineer in India.—MR. ROWLAND BATEMAN SMYTH (Late of the Geological Survey of India.)

Bankers.—MESSRS. HENRY S. KING & CO., 65, Cornhill,
E.C.

Brokers.—MESSRS. LANE BROTHERS, 22, Threadneedle
Street, E.C., and Stock Exchange.

Solicitors.—MESSRS. SLADE & MUNK, St. Clement's House, Clement's Lane, E.C.

Auditors.—MESSRS. JOHN F. LOVERING & CO., Chartered Accountants, 77, Gresham Street, E.C.

Secretary.—MR. A. W. BROWNING.

Offices.—Winchester House, Old Broad Street, E.C.

This Company has been formed to acquire 250 acres or thereabouts of Freehold Land with the Perpetual Mining Rights, situated at Wadjra Karur, in the district of Annantapur, in the Presidency of Madras; and also the Perpetual Mining Rights of 304 acres or thereabouts situated in the same district, making in all 554 acres.

Wadjra Karur, which is within nine miles of Gundakul Junction, Madras Railway, is the native Indian term for "Village of Diamonds;" it has for years been known, as its name indicates, as a district where diamonds have been found. These, however, have not been the result of scientific working by machinery, the natives contenting themselves with scraping the surface during the rainy season, or soon after, when the diamonds thus discovered are sold to native princes or dealers in Madras and elsewhere.

Some time since a very large diamond was found at Wadjra Karur,

weighing 67½ carats, and was offered to Messrs. P. Orr & Sons, of Madras, the well-known diamond merchants and jewellers, who, struck with its appearance and size, after consultation with Mr. John Brukowsky, the experienced diamond expert of London and Zurich, purchased it, and having made enquiries, they decided to jointly purchase the lands and mining rights at Wadjra Karur herein referred to. Accordingly, negotiations were set on foot, and some idea may be formed of the labour involved in this when it is stated that there are 44 deeds of conveyance from nearly as many native owners. The legal titles have been examined by the eminent firms of solicitors, Messrs. Barclay and Morgan, and Messrs. Wilson and King, of Madras.

The circumstances under which Mr. John Brukowsky advised and joined in the purchase of the Diamond Fields is best told in the following statement made by that gentleman:—

MADRAS PRESIDENCY DIAMOND FIELDS, LIMITED.—(Continued.)

41, BASINGHALL STREET, E.C.,
LONDON, 9th March 1888.

Some years ago, hearing of the discoveries of diamonds in South Africa, and having been connected with the precious stone trade for the last twenty years, I proceeded to inspect the Diamond Fields in Kimberley and at Jagersfontein. Shortly after this, when at Ceylon, I received a letter from Mr. R. G. Orr, of the eminent Firm of Messrs. P. Orr and Sons, Madras, informing me that a remarkable diamond had been discovered, and requesting me, as a special judge of these stones, to come immediately to Madras and inspect the stone. I then went to Madras, and as soon as I saw the stone I said, "Don't let it go for any amount," and the seller received what he asked for the gem. I at once enquired where this wonderful stone came from, and the seller informed me that it came from Wadjra Karur, and this was confirmed by several natives through whose hands the stone had passed.

The gem above referred to, now known as the Gor-do-Norr Diamond, was sent to Gebrüder Houy and Co., of Hanau, Germany, the diamond cutters, where it was cut and polished, and weighs $24\frac{1}{2}$ carats, and for purity of lustre and brilliancy is said to be unsurpassed by any stone in existence.

I then proceeded to Wadjra Karur, and, to my great astonishment, found the geological appearance similar to the African which I had so recently left.

The hillocks are thrown up evidently by volcanic action; the gravel, the floating reef, and some blue clay (thrown up where wells had been sunk) all proved conclusively to my mind that I was in the presence of probably one of the greatest diamond mines in the world.

I stayed in the neighbourhood for some two months, and the natives from the village brought me rough diamonds, which I bought: and very fine ones these were. Some of these diamonds I sold through Mr. R. E. North, of Hatton Garden, London, and they all realised very high prices, the Indian stones being, on account of their lustre, worth considerably more than the Cape stones.

Mr. Orr, of Madras, had continually been buying stones from Wadjra Karur, and is doing so at the present time. One weighing $18\frac{1}{2}$ carats in the rough, from this field, cut down to $6\frac{1}{2}$ carats, was ultimately sold, through Mr. W. Carlton Wood, for £675, being £105 per carat, to Messrs. Tiffany, of Paris and New York. Last year I bought some stones from this village, and as an indication of the class and quality of the gems, I may mention that I sold one weighing about $6\frac{1}{2}$ grains to Messrs. Biedermann, of Vienna, for 700 florins.

I may add that, having satisfied myself that the property was diamondiferous ground, I consulted with Mr. Orr, and his firm and myself jointly acquired 554 acres freehold land, or mining rights at Wadjra Karur.

The configuration of the place indicates the basin formation, as well as the pipe, so well-known to South African miners, and if it is opened up according to modern scientific diamond mining, I have the most profound conviction that the results will equal those of Bultfontein and Jagersfontein in quantity, while in quality, stones of infinitely superior lustre and value may be expected.

(Signed) J. BRUKOWSKY.

The above diamond is referred to by Professor Church, M.A., F.C.S., F.I.C., in his South Kensington Museum Art Hand-book, entitled "Precious Stones." He says, the "Gor-do-Norr" has a specific gravity of 3.527; and Mr. R. B. Foote, F.G.S., Superintendent, Geological Survey of India, referring to this diamond, in his Notes on the Geology of parts of Bellary District, says: "Mr. R. G. Orr has now a Wadjra Karur diamond for sale, valued at more than £10,000. It is a large and remarkably fine stone."

The Company has the option of purchasing the Gor-do-Norr diamond on advantageous terms, and offers it for sale at the price of £15,000, which, though leaving the Company a handsome profit, the Directors are assured by competent experts in precious stones is a very moderate price to a purchaser.

The Wadjra Karur properties have been inspected, by request and instruction of Messrs R. G. Orr and J. Brukowski, by Mr. Andrew Copley, and Mr. R. Bateman Smyth, Mining Engineer, whose Reports are enclosed herewith, and to which special attention is directed.

MR. ANDREW COPLEY SAYS:—"The natives of India, past and present, have shown no disposition to engage in deep mining. It may be that this is why they have not hitherto developed this most remarkable formation. Some of the oldest Cape diamond miners may still recollect that the famous Colesberg Kopje—by which name the Kimberley Mine was known in 1870—was rushed and abandoned six times before people realised that they had been coquetting with what is now one of the richest known diamond mines.

"Taking at this time a retrospective view of the whole, I see no reason to doubt (water being abundant and labour cheap) that with proper machinery this property will develop into a valuable diamond-mining industry."

MR. R. BATEMAN SMYTH SAYS:—"The land having been secured without any liability for royalty, and I having tested and conclusively proved the extent and quality, nothing more remains but to open out the Mine in accordance with modern scientific methods. When a shaft has been sunk right down into the blue clay pipe, and the property fairly developed, the result will, in my opinion, be as abundant and satisfactory as the diamond mines of Kimberley and Griqualand West."

It will be observed from the enclosed Report of Mr. R. Bateman

Smyth that the basin or pan at Wadjra Karur covers between 60 and 70 acres, whilst the extent of the Kimberley Mine consists of but a few acres.

So soon as this Company has got its machinery at work, and has proved to the world the value of the Wadjra Karur property, which the Directors are advised will be in about six months, it is the intention to mark it out in blocks, as at Kimberley, and in addition to working, will either form subsidiary companies, or sell or lease portions from time to time on the plan pursued by the South African Exploration Company, whose shares, 10s. paid, now stand at £18 per share.

As to the principal Diamond Companies at work, the profits from holding their shares will be seen by the following table of premiums at which they stand, and the Directors believe there is every reason for the shares of this Company, as a parent Company, rising to a high premium.

Name of Company.	Paid-up Capital.	Paid up per Share.	Present Price.
De Beer's...	£2,510,000	£10	£42
Kimberley Central ...	1,422,950	10	41
New Jagersfontein ...	129,000	10	21
Bultfontein ...	140,000	5	22
United Diamond ...	.....	1	3½
Klepfontein ...	.....	1	3

The De Beer's Company have just declared a quarterly dividend at the rate of 40 per cent. per annum and the Kimberley Central Company at the rate of 36 per cent. per annum.

India is known as the natural home of the diamond. The Diamond Fields of India have been celebrated from remote antiquity; and, with the exception of Brazil, until the South African discoveries, most of the diamonds in the world came from there, and this without any scientific working on modern principles. The clear blue-white water of the Indian stones has never been equalled either in size or quality, by the output of any other country.

Most of the historical and renowned diamonds have been found in India, and, amongst others, the following:—

Name of Stone.	Weight in the Rough.	Weight when Cut.
The Nizam ...	340 carats	.....
The Great Mogul ...	787½ "	279½ carats
The Great Table ...	.....	242½ "
The Regent ...	410 "	136½ "
The Austrian Yellow ...	.....	139½ "
The Koh-i noor (the Property of Her Majesty) ...	103 "	102½ "

and now from the Wadjra Karur Fields, before they are opened out, another is given to the world, viz., the Gor-do-Norr, surpassed in quality, brilliancy and purity by none of the above, but superior to most of them.

The amount to be paid for the Freehold Land and Mining rights is £1,60,000, payable in shares of the Company to be issued as fully paid up. This will leave ample working capital.

The Directors do not think it necessary to add to the above statements, except to draw the attention of intending investors to the small amount of the Company's capital as compared with the existing diamond companies, and to the enormous possibilities consequently in favor of the shares when further discoveries are from time to time announced.

The following contracts have been entered into, viz., dated 15th March, 1888, between Robert Gordon Orr and John Brukowski of the one part, and Charles Henry Strutt of the other part; dated 17th March, 1888, between the same parties; dated 16th March, 1888, between Robert Gordon Orr of the one part, and Charles Henry Strutt of the other part; dated 17th March, 1888, between Rowland Bateman Smyth of the one part, and Charles Henry Strutt of the other part; dated 15th March, 1888, between Charles Henry Strutt of the one part, and Wilfred Hargrave of the other part; dated 9th April, 1888, between Charles Henry Strutt, the Vendor, of the one part, and Alfred William Browning, on behalf of the Company, of the other part.

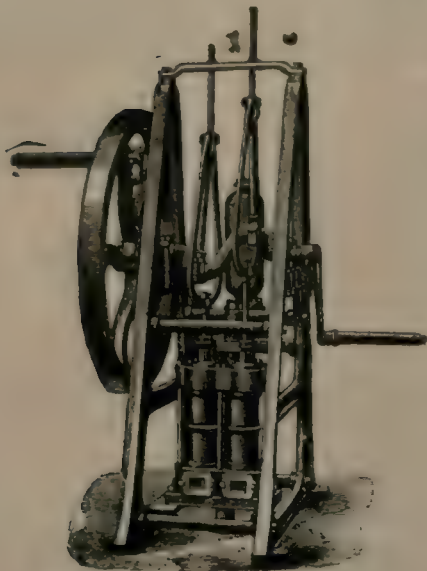
The Vendor, who is the promoter, will pay all expenses attending the incorporation and registration of the Company, and also all underwriting, brokerage, commissions, printing, advertisements and expenses attending the issue of the Company's capital up to and including the first allotment. These and other arrangements which have been entered into by the Vendor with various persons, may technically constitute contracts within the meaning of the 38th section of the Companies' Act, 1867. Applicants for Shares must therefore be deemed to waive the insertion of dates and names of the parties to any such arrangements or Contracts, and, in order to prevent any questions, must accept the above statements as a sufficient compliance with Section 38 of the Companies' Act, 1867, and applications for Shares will be received subject only to this provision.

With reference to the above announcement, the Company having proceeded to allotment of shares in London, THE COMMERCIAL AND LAND MORTGAGE BANK, LIMITED, MADRAS, is authorized to receive applications for 2,000 shares (reserved for subscription in India) in the MADRAS PRESIDENCY DIAMOND FIELDS, LIMITED. The Rupee value of a share is Rs. 75, Rs. 30 being payable on application, further calls of Rs. 15 each being made as required, at intervals of not less than one month. Allotments in Madras will be made in order of application, telegrams taking precedence; the subscription list will be closed on Saturday, 16th June. Currency Notes of any Circle and Cheques on Indian Banks received at par.

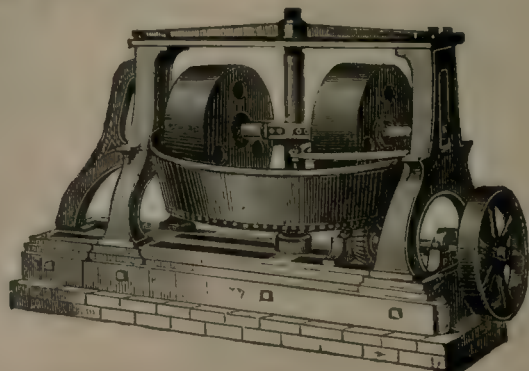
Cheques on England also accepted if more convenient to subscribers. Forms of application and copies of Articles of Association obtainable from the Commercial and Land-Mortgage Bank, Madras, and from P. ORR AND SONS, Agents, Madras.

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NOW READY.

"Artesian Borings in the Sunderbunds."

As the issues of the journal containing the articles headed as above were out of print, and sufficient inducement having offered, the matter was reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

Price Rs. 2 per copy.—Cash.

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Obituary.

CONOR.—At Mhow, Central India, on 26th May 1888, of small-pox, Major A. S. W. Conor, B. S. C., Executive Engineer, P. W. D.

INDIAN ENGINEERING.

SATURDAY, JUNE 9, 1888.

THE HOOGHLY "JUBILEE" BRIDGE.

THE paper on the erection of the Hooghly Bridge read by Sir Bradford Leslie at the Institution of Civil Engineers on 24th January, and the discussion thereon, will possess more than ordinary interest for Indian Engineers; both on account of the value of a detailed description of the methods employed in getting in the foundations and erecting the superstructure of a difficult work, and on account of the opinions elicited during the discussion from the leading members of the profession.

Most of the so-called large bridges in India do not after all present any great features of interest to the Engineer so far as execution goes. There is the monotony of so many wells to be sunk, and so many spans to be erected, generally on a staging; plenty of hard and dull work, with scope for ingenuity only in improvements of minor details, and in making good arrangements for the supply of materials; but nothing to furnish material for a paper for the Inst. C. E., though it is much to be desired, that all particulars of cost and improvements in detail of such works should be published in a short paper locally where they would be of real use.

In this case, however, not only is the bridge remarkable from the size of the spans, the largest in India, but for the arrangements adopted in constructing the foundations and erecting the superstructure, both of which are similar to those already successfully employed by Sir Bradford Leslie at the Gorai Bridge on the Eastern Bengal Railway, and described by him in a previous paper to the Institution.

The boring gear for sinking the caissons seems to have acted so well to a great depth, that we wonder it has not been tried by other Engineers on the many bridges with deep foundations since constructed, in preference to the tedious process of dredging.

The account of the breaking loose and recovery of one of the caissons is most instructive, as is also the detail given of the mooring arrangements necessary to guide such a mass as a caisson 66' x 25' in 30 feet of water running at five miles an hour.

The foundation arrangements do not seem to have elicited many remarks, the points raised in the discussion being principally confined to the general arrangement of the bridge and mode of erection, with a few remarks on the superstructure, which, though not the subject of the paper, necessarily forms part of the subject in discussing the bridge.

The outline was unanimously condemned from an æsthetic point of view, and there is no doubt that to the unprofessional eye it presents the appearance of a bridge of three ordinary spans, of which the middle piers have, by some curious accident, slipped out of their proper places.

This is the more to be regretted, since there is no special economy in the form adopted, a well designed

parallel girder and cantilever, being quite as economical. Indeed, as pointed out in the discussion, this bridge is rather a heavy one. The curved ends are also objectionable on theoretical grounds.

In the very meagre details of the testing given in the paper, no notice was taken of the rising of the unloaded end of the cantilever about which there has been some discussion in our columns. The absence of any details of the action of the live load, which would have been instructive, was commented on by Sir D. Fox, and it appears a pity that this point should not have been elucidated.

In the matter of the testing also, we strongly recommend the remarks of Mr. M. amEnde and Sir Bradford Leslie on deflection, to the Consulting Engineers of this country. Nothing is more common than to see the deflection of a girder under the proof load quoted as satisfactory, on the bare statement of the figures, without any reference to the many details that affect it.

The fact is, that the deflection test is no guarantee whatever of the stability of a structure, though excessive deflection points to something wrong. Nearly all of the iron bridges in America that have failed have stood a satisfactory test. To be any use at all, the observed deflection must be compared with that calculated from a knowledge of the modulus of elasticity of that particular metal, and of the live load strains. Then perhaps some conclusions may be drawn.

We have seen it suggested that the small deflection in a bridge was due to the rivetting being hydraulic. Now the workmanship does undoubtedly affect the deflection of a girder when first swung, but once it has taken its bearing, we do not see how it can affect the deflection under the moving load, at least within the limits of ordinary workmanship.

Mr. B. Baker's remarks on the action of continuous brakes upon the piers are valuable to the professions generally in these days of continuous brakes. But we do not know that they would be of any special interest in this country, where the use of such brakes is, and is likely to remain, very limited.

The question of a continuous girder was raised by some of the members, who were not aware that the bad nature of the foundations in Indian rivers, as a rule, precludes the use of this type. Indeed, the only large span bridge we can call to mind, where it would have been practicable to use this type, is the Sukkur Channel of the bridge over the Indus at Sukkur, described in the Roorkee Professional Papers. Here the foundations are rock and the span large enough (275') to make it worth while. It seems however to be generally concluded in America, where economy is most studied, since the design is included in the tender, that a continuous girder is not more economical than discontinuous spans of proper proportions.

The employment of suspension on links instead of rollers for expansion gear elicited some remarks. Sir B. Leslie gave two very useful examples from his personal experience of injury to bridges in India from neglect to the rollers.

This is a point which we fear is too often neglected; a bridge once erected is supposed to take care of itself, and such a troublesome detail to inspect as the roller gear, hardly ever gets looked at, while we should suppose that a few average dust-storms, would accumulate enough dirt between the rollers to form a serious obstacle to free expansion.

The roller arrangement is, however, so convenient, that it is not likely to be superseded by the hanging link, but we think the form of roller lately introduced, in which each roller is only a sector of the usual width of a roller of large diameter, is likely to come into use. We believe it was invented by an Australian Engineer whose name we cannot just now recall.

Cognate to the subject of impeded expansion is that of the centre part of the cantilever between the piers, where expansion is only possible by the bending of the massive steel piers.

This point was noticed in the discussion, but no satisfactory explanation was given as to what extra strains were induced, nor whether they had been provided for in the design.

We will conclude with a suggestion that these strains should be measured, which could be done in the following way, applicable also to any cases of restricted expansion :—

Fix a rod, preferably an iron pipe, to the girder at one pier, and let it extend to the other, being supported by rollers or hangers, so as to be able to move with as little friction as possible. The free end being pinned to an index, which is pivotted to the girder, the motion of the end of this index will be an exact measure of the restriction to the expansion of the girder, for if the expansion of the girder were free, it will equal that of the rod, and no motion of the index will take place. This difference in expansion of a free rod and of the girder can be directly translated into the strain on the latter, which in this case will probably be worth taking into consideration.

IRRIGATION IN THE NORTH-WEST PROVINCES.

THE saying, 'better late than never' spontaneously suggested itself to us on opening the Irrigation Revenue Report for the year ending 31st March 1887, which has been reviewed by the Local Government almost one year later. But what has been lost by the delay is more than gained by the masterly way in which the report has been compiled. It is full of interest, not only to the 'professional,' but also to the ordinary reader, and reflects great credit on the canal officers concerned. The total outlay on the capital account in the North-Western Provinces and Oudh for 1886-87 was Rs. 19,09,628 and to the end of that year Rs. 7,70,59,223, the former expenditure being Rs. 3,31,191 more than in 1885-86. Owing to the construction of the new Nadrai aqueduct there was an expenditure of Rs. 6,99,994; but on the Betwa Canal there was a decrease of Rs. 4,27,534 owing to the completion of works. On the Agra Canal there was an increase of Rs. 71,930, the main portion of which was incurred in

extending and completing the distributary system. The gross assessments of the year under review were Rs. 51,40,970, and the working expenses Rs. 25,64,096, the net revenue was therefore Rs. 25,76,874 or 3·34 per cent. on the entire capital.

Leaving out the Betwa Canal, which is considered a protective work, the return is 3·60 per cent., as against 4·95 in the previous year. The interest charge on the capital amounted to Rs. 27,41,369, deducting from this amount the net revenue, the assessments shew a deficit of Rs. 1,64,495, against a profit of Rs. 8,69,419 in the previous year; but if the Betwa Canal is excluded, the net revenue comes up to Rs. 26,30,065, the interest charge to Rs. 25,91,072, and there is a surplus of Rs. 38,993. The actual increase realised from all sources during the year was Rs. 57,17,108; after deducting all expenses, including interest charges, the net revenue was Rs. 4,11,643, against Rs. 2,97,071 in 1885-86—not taking into account the Betwa Canal, the gross income was Rs. 56,96,408, the total charges Rs. 50,78,820, and the net revenue Rs. 6,17,588. The cost incurred by the Civil Department in collecting the water-rate was Rs. 1,20,915 or 3 per cent. in gross collections, as against 3·13 per cent. in the previous year. The total irrigated area of the *kharif* and *rabi* crops during the year under review was 1,363,815 acres, as during the *kharif* season the rainfall was above the average and well distributed, the area irrigated therefore decreased and was 160,438 acres less than in the previous *kharif*. The *rabi* season was also favorable, the timely rains of October helped the sowing of the crops without requisitioning canal water; there was a demand for it in December, but the general rainfall of January came to the cultivators' aid, and there was a decrease of 185,523 acres in the irrigated area.

The double cropped area decreased by 116,733 acres, and the percentage fell from 18·24 to 14·31. In 1886-87, 7,928 villages received water from 34,241 outlets in the distributaries of the five main canals. The total value of crops raised with canal water was Rs. 4,44,17,015. The maintenance charges per acre irrigated during 1886-87 was in the case of Upper Ganges 1·60, Lower Ganges 2·34, Agra 2·46, and Eastern Jumna 1·09. The actual expenses on the Upper and Lower Ganges Canals were Rs. 8,268 and Rs. 35,411, respectively, less than in the previous year, but there was an increase on the Agra Canal of Rs. 70,381, and on the Eastern Jumna Canal of Rs. 24,737. In the matter of navigation operations there was a loss of Rs. 15,298 on the Upper and Lower Ganges Canals, against a loss of Rs. 11,898 in the previous year. Until the new Nadrai Canal is completed and constant running introduced on the Cawnpore branch, no material improvement can be expected in this direction.

The actual receipts realized from minor sources of income during the year under review are as follows:—Plantations Rs. 1,75,542; water-power Rs. 89,361; miscellaneous Rs. 48,540. From observations carefully recorded it appears that, with few exceptions, the spring level of the Upper and Lower Ganges Canals, was, in the main, lower than in 1885-86, and it is hoped that a few years of

average rainfall will bring it down to the level at which it stood before 1884 and 1885, which were exceptionally wet years. For the first time the Betwa Canal supplied water for irrigation purposes during both seasons. The maintenance charges came up to Rs. 76,348, and the income Rs. 23,157, shewing a deficit of Rs. 58,191. In regard to minor works on the Rohilkund division, there was a loss of Rs. 41,435, as compared with a loss of Rs. 35,929 in the previous year. In the Raj River Canals there were net profits to the extent of Rs. 11,454, against Rs. 15,478 in 1885-86. On the Dun Canals there was a net profit of Rs. 41,012, against Rs. 44,056 in 1885-86, and on the Bundelkund Lakes there was a loss of Rs. 4,318, against a loss of Rs. 6,578 in the previous year.

CROWN LANDS AND CAPITALISTS.

We are glad to notice from a recent *Resolution* that in deference to public representations and private grievances, the Bengal Government is now prepared to grant *license to search for minerals* on Crown lands in the Chota-Nagpore Division and elsewhere.

Applicants for the *exclusive privilege* should in the first instance *apply* to the Collector or Deputy Commissioner of the District submitting *plans and specifications* of the *area*, which will ordinarily not exceed *half a square mile*, wanted; and on the *application* being *accepted* the *license* will be *issued* or *granted* on the following conditions:—

- (a). The license will be for *prospecting* only, and be available for *6 months*.
- (b). The *rent per acre* will be *one rupee* or less, payable in advance to the Collector or Deputy Commissioner, on the date of granting of license.
- (c). The *licensee* will have *preferential right* to mining after *effectual exploration* of the area.
- (d). The *licensee* will be held responsible for *surface damages* assessable at not more than *25 times* the value of the land then obtaining.
- (e). The *Lieutenant-Governor of Bengal* will be the *arbiter* in all questions affecting the observance or non-observance of these conditions, and his *decision* will be *final*.
- (f). The *Licensee* cannot *enter* the ground without a written *permit* from the District Officer,
- (g). Who on receipt of *application* for permission to search, shall find out if the *land* belongs to Government, and what, if any, *objection* there exists to grant such permission; and
- (h). *Finally* if there should appear *no objection* the said officer shall forthwith put the *applicant* in *possession* and grant him the necessary *license*.

These seem to us, and should be considered, very fair conditions by willing investors or explorers. There is no question that in these days of rapid progress there should be as little of *red-tapeism* and harassing delays as possible, and in the present case the Government of Bengal has shown itself equal to the occasion by empowering District Officers and thereby minimising the retarding influence of circumlocution which permeates, we are sorry to see, all departments of the administration.

Notes and Comments.

EXPENSIVE SUPERVISION.—Lieutenant-Colonel Clarke, R.E., has assumed charge of his appointment as Superintendent, Public Works Workshops and Stores, Madras.

IMPARTIALITY.—The *Civil and Military Gazette* says: A camel, a cow, a donkey and a man were run over and killed on the North-Western Railway on Monday (4th instant) night.

THE DELHI-KALKA LINE.—Another scheme with which Mr. Duff Bruce is associated—the construction of a direct line from Delhi to Kalka, *via* Umballa—is believed to have received the preliminary sanction of the Secretary of State.

NEGAPATAM WATER-SUPPLY.—Mr. J. W. Rundall, M.I.C.E., Superintending Engineer, has proposed to meet the difficult question of a water-supply for the port and town of Negapatam by sinking wells in the bed of the Vettar river and pumping therefrom.

AT LAST!—This week's *Gazette* announces the promotion of Mr. H. J. Richards, Executive Engineer, 1st grade, Burma, Superintendent of Works, Mandalay, to Superintending Engineer, 3rd class, temporary. This is tardy justice, but better late than never!

OBITUARY.—We regret to record the death of Mr. H. W. Hughes, the District Engineer of Barabanki, who died last week at Lucknow. Mr. Hughes was a supporter of this Journal, and his articles are now appearing in it. He has two brothers high up in the P. W. D.

MYSORE P. W. D.—We find that the revised scale of Engineer Establishments for the Mysore Public Works Department, Local, provides for one Executive Engineer of the 1st grade on Rs. 750, two 2nd grade on Rs. 600, three 3rd grade on Rs. 500, and two 4th grade on Rs. 400.

ANOTHER PUBLIC WORKS MINISTER PROBABLE.—It is said that the appointment of the first Lieutenant-Governor of Burma is to be offered to Sir Charles Elliot, and that Sir Charles Crosthwaite will succeed him in the Council. Perhaps some might view the expected change as an advantage to the Department.

A GLOOMY PROSPECT.—After the 20th of July there will be no compulsory retirement of a Royal Engineer General on the old list, until Sir Howard Elphinstone succumbs on the 12th of December 1891, and then three years will elapse before there is another. Rather a dismal look out for the senior Colonels.

KISTNA RIVER.—A revised estimate, amounting to Rs. 12,000, for surveying the Kistna river, which it is proposed to conserve under Madras Act VI. of 1884, is sanctioned in supersession of the estimate sanctioned. Detailed charts will be prepared on a scale of 16 inches to a mile, and the general one to a scale of 6 or 8 inches to a mile.

NOT OUR FAULT!—We are sorry to say that owing to the inability or unwillingness of the Government of India Secretariat to furnish us with the papers referred to in the recent Resolution relative to the grading of Subalterns of the Royal Engineers on first appointment to the P. W. D., we must defer or withhold our promised comments on this subject *sine die*.

THE MYSORE GOLD MINES' EXTENSION OF LEASES.—The Mysore Government views with satisfaction the

recent progress of gold-mining operations, and accordingly, under the advice of Colonel Bowen, the P. W. D. Secretary, announces that it is now prepared to extend at once, for a further period of twenty years, the existing terms of all leases under which mining operations have made substantial progress.

RAILWAYS IN MADRAS.—The Government of India in a resolution forwarded to the Government of Madras in connection with the Railway from Bezvada to the Hyderabad frontier, mentions that the Agent of the Nizam's Railway was recently asked on what terms the Company would be prepared to undertake the working of the line, and it may be assumed for the present that the Company will work the line.

"GORDON RAILWAY VIADUCT."—The Kaveri at Seringapatam is crossed by the S. M. Railway by three bridges. No. 1 bridge has nine 30 feet arches and twenty-four 27½ feet arches. No. 2 has thirteen 30 feet arches and sixteen 27½ feet arches. No. 3 bridge has two 25 feet arches, and four 27½ feet arches. These three bridges over the three branches of the Kaveri are of stone and number 68 arches. The work was done under the supervision of Colonel LeMessurier, R.E., at a cost of 1½ lakh of rupees.

PROPOSED HOOGHLY SUBWAY.—Mr. Duff Bruce, in conference with Mr. Greathead, the Engineer for the Subway now being constructed under the Thames, is preparing plans and specifications for a tunnel under the Hooghly, to connect the East Indian Railway with the Kidderpore Docks. The Railway Company are disposed to consider the proposal favorably, and from borings which have been made in connection with the construction of the docks, no difficulty is anticipated in the construction of the tunnel.

THE BIRTH DAY HONORS LIST.—*To be K. C. I. E.:*—Guilford Lindsay Molesworth, Esq., C.I.E., Consulting Engineer to the Government of India for State Railways. *To be C. I. E.:*—Major William Sinclair Smith Bisset, Royal Engineers, Agent to the Bombay-Baroda and Central India Railway; Henry Irwin, Esq., M.I.C.E., Superintendent of Works, Simla Imperial Circle; Captain Buchanan Scott, Royal Engineers, Deputy Consulting Engineer for Railway to the Government of India, Calcutta.

DE HAVILAND'S ARCH.—Not far from the Railway Station at Seringapatam stands the experimental arch constructed by Captain de Haviland, of the Madras Engineers, who was attached to the garrison of Seringapatam from 1808 to 1810. It is a very interesting structure. The length of the span is 112 feet, breadth 4 feet, thickness at the lower end 5 feet, and at the crown 3 feet 10 inches. It is supported at either end by buttresses of stone set in chunam. The arch vibrates, and when any man dances on the crown the vibrations can be clearly noticed.

THE BENGAL P. W. D.—The old saying that it never rains but it pours, is applicable to the Bengal Engineering Establishment at the present moment. Mr. Martin's promotion to Chief Engineer has given a step to Mr. Joll, who relieved him. Mr. T. H. Wickes goes to the N.-W. P. and Oudh and Major McArthur relieves him while Mr. Shawe relieves Major McArthur in the Irrigation Under-Secretaryship. Mr. Anley will not go before next month, and it is possible that his departure will determine many questions of promotion and transfer which are now only matters for speculation.

FIFTY-FIVE YEARS' ORDER.—Under Rule 1, Section 110, of the Civil Pension Code, authority to permit the retention in the service of non-gazetted officers between fifty-five and sixty years of age is delegated to certain heads of departments. A selection of officers to be similarly empowered will be made in the Military and Public Works Departments. Every sanction will expire on the last day of the official year, and must then be renewed if further retention is considered desirable. Additions to the list will be made from time to time by Government in the departments concerned.

ADOPTION OF A MEMORIAL.—The meeting of the officers of the Uncovenanted Service, held on Monday last, passed off most successfully. Every Uncovenanted Officer in Simla was present. Sir Guildford Molesworth presided, and speeches in support of the claims of the service were made by the Chairman, Mr. Eliot, Mr. G. R. Macdonald, Mr. J. E. O'Connor, Mr. Ribentrop, Mr. Buckley, and Dr. George Watt. The memorial to the House of Commons was adopted and signed, and a telegram was sent to Mr. H. S. King informing him of the meeting and thanking him for his support to the cause of the service.

THE NILE FLOOD OF 1887.—Sir Colin Scott Moncrieff has prepared notes in reference to the Nile flood of 1887, which was not so high as that either of 1874 or 1878, but still may be classed as one of quite exceptional magnitude. Sir Colin says:—When face to face with inundation we naturally looked for records of previous floods. It would have been invaluable to us to have known where were found the weakest points, what measures were found effective and what ineffective. But even of these two great floods within the last 13 years not an Engineering record was forthcoming any more than if they had occurred in the reign of a Pharaoh.

PREPOSTEROUS PROPOSALS.—Dr. Laing, Sanitary Commissioner, Madras, recommended that Government wet cultivation should be kept at a distance of a mile from large towns and Municipalities, and three-fourths of a mile from smaller towns and villages. We are afraid that Dr. Laing has yet much to learn about the Presidency over the health of which he presides. If his suggestions were carried out, it would reduce the most fertile tracts of Southern India, its deltaic areas, notably that of the Cauvery, into barren wastes, and not only reduce the population of the country to starvation, but diminish the public exchequer by 90 per cent.!

WHEAT CROPS OF INDIA.—In Bengal the past season has been more generally unfavourable to the wheat crop than in the preceding year. In the N.-W. P. and Oudh the total area under pure wheat has this year been returned at 4,952,354 acres, or within a few thousand acres of the area, returned last year. But, compared with the normal wheat area a deficiency appears of over 2 per cent., and no less than 6 per cent. as compared to the area reported for 1885 and 1886. The figures for the Central Provinces indicate that the area under wheat during the current season exceeded that of the previous year by no less than 258,400 acres, and this, too, although the area of the previous year was by no means an abnormally small one.

SUB-MARINE MINING.—Royal Engineer soldiers employed on sub-marine mining duties are to be allowed a continuance of their former consolidated rates of working pay, pending the issue of orders for the improvement of the

military position of these men. At the present time, when the Government at home are laying such stress on the formation of Volunteer Sub-marine Mining Companies, for the defence of the home posts and forming new sub-marine Royal Engineer Mining Companies, it is bad policy for the Indian Government to cut down the already too low allowances of the few good men out here who are already sufficiently disgusted with their experiences of the Indian climate without being made more disgusted by reduction to British rates of pay.

MR. H. JOLL.—Mr. H. Joll's appointment to be Superintending Engineer, Western Circle, P. W. D., Bengal, in place of Mr. E. J. Martin, forms another item in the complete transformation which Bengal is now undergoing in respect of the administration of the P. W. D. Mr. Joll's abilities are well-known, and have long ago marked him out as one of the future Superintending Engineers. His experience, while Inspector of Local Works in Patna, will stand him in good stead in his duties in the Western Circle, which comprises the Patna Commissionership, and through being nearer Headquarters, his sound knowledge and thoroughly practical opinions will be more available where they will be best appreciated—*viz.*, at the fountain whence all Public Works schemes flow.

MR. T. H. WICKES.—The many friends of Mr. T. Haines Wickes, Superintending Engineer, South Western Circle, P. W. D., Bengal, will be gratified to hear of his selection to act as Chief Engineer, Buildings and Roads Branch, N.-W. P., in place of Colonel J. P. Steel, R.E., who was recently gazetted to succeed the late Colonel D. Ward, R.E., and who now proceeds on furlough. The N.-W. P. is to be congratulated upon securing so genial and popular a Chief, while Bengal can ill afford to spare one who has been a friend to the many and enemy to none. Especially will the younger members of the service feel his absence, for as a sound adviser in matters private or professional, and as a kind and ready sympathizer, there has been no one in Bengal like Mr. Haines Wickes.

THE BENGAL-NAGPUR RAILWAY AND THE COAL COMPANIES.—It is believed that the Asansol route was sanctioned by the Government subject to the following conditions, which have been accepted by the Company:—(1). A coal branch from the main line on the north bank of the Damuda river to the coal-fields through which the old or Sitarampore line would have passed. (2). Equal rates should be levied by the Company from all places on the branch. (3). The supply of certain sidings required by the Equitable. Why the Equitable should of all other companies be entitled to *certain sidings* it is not quite clear. Sidings from the main branch should, we think, be so arranged as to serve all the coal proprietories equally and draw all available traffic therefrom.

INSPECTOR OF LOCAL WORKS, PATNA.—The vacancy caused by the appointment of Mr. H. Joll to be Superintending Engineer, Western Circle, in place of Mr. E. J. Martin, who has just taken up his new duties as Chief Engineer, will doubtless be the subject of much striving after, for it is a specially interesting and a very agreeable charge. If a suggestion offered from outside could be of any service, the name of Mr. C. A. Mills seems to recommend itself to those who know his experience and abilities. With great self-denial he proceeded to fill the vacancy

at Chittagong, a district he had been obliged to leave not long before on account of ill-health, and it would be an act of fairness to make the offer to him. He has had besides long and useful experience whilst District Engineer of Gya, eminently fitting him for this post.

INDIAN COKE AND COKE-MAKING.—The E. I. Railway have gone in for improved coke ovens to make their coke SALEABLE. At Borraah Colliery the "New Beerbhoom" have gone in for improving the quality of a first-class coke, by having all the dust crushed to one size, which is very successful. The American Manager of the Burrakur Coal Company has gone in for a machine for crushing dust for coke. Of the two machines brought out, the Burrakur one is the best, does the best work, with the least expense. Both are by different makers. We hear that Dr. Saise, not to be behind, is going in for a dust crusher. Ritter von Schwartz has stirred these coal companies up. As he is the largest purchaser of coke in the market, he insists on using none but the best for his blast furnaces; he considers it a waste of time and expense to load his furnace with coke little better than clay.

INDIAN STATE RAILWAYS.—"Disgusted and Discontented" writes to a contemporary: The expenditure in India on State Railways is now about 2½ millions annually. A very little laxity in supervision would be sufficient to increase the cost 1 per cent., which would not be noticeable when spread over a large number of works, and the sum total of this would amount to 2½ lakhs—sufficient to give 200 Engineers (exclusive of Chief and Superintending ranks) Rs. 100 a month all round, or would cover the cost of a fair scheme of retirement. It is needless to say that the staff at present is disgusted and discontented, but their sense of duty and professional pride have not yet allowed any effect to be felt. How long this will continue it is difficult to say; but the period will probably be brief, for there is a limit to the endurance of wrong, and even a worm or an Englishman will turn when trampled on. The present Public Works Minister would do well to ponder this subject, and not let a penny-wise-and-pound-foolish policy be the outcome of his incumbency of the post.

JUST APPRECIATION.—The Bombay Port Trust have recorded that the way in which the work of Prince's Dock Extension has been carried out is also most creditable to the untiring energy and close supervision of the Engineer, Mr. George Ormiston, and his staff, and the Trustees most heartily congratulate them on the success of their efforts. Subject to the sanction of Government, the following sums may be paid to the Engineer and to the members of his staff named as a proof of the Trustees' appreciation of their valuable services:—

		Rs.
Mr. Ormiston, Engineer	...	7,500
.. Lym, Assistant Engineer	...	1,500
.. Squire, Assistant Engineer	...	1,500
.. Messent, Assistant Engineer	...	600
.. Smeaton, Mechanical Superintendent	...	500
.. Ruttonjee Dhunjeebhoj, Honorary Assistant Engineer	...	500
.. Hurrichand Nillajee, Head Surveyor	...	400
Total	...	12,500

PROGRESS.—A correspondent writes:—Combinations are a feature of the day. Ladies favor them in the way of costumes and coiffures, men go in for all sorts of collapsables of various import, Government believes firmly in doubling up and "consolidating" pay and promotion. The

last noteworthy combination of which we have heard is a new type of torpedo boat, the invention of Messrs. Yarrow and Co., of Poplar, which can be used either as a torpedo boat, a gunboat, or a steam pinnace. It is contended that this new combination is less crank, uncomfortable and "wet" than previously existent sea-going vessels. Messrs. Yarrow's boat, not long ago, voyaged under steam from the Thames to Portsmouth in rough weather, and was not wrecked. Great elation is being felt in channel ports in honor of this auspiciousness. *Apropos the Nile*, a new steel screw steamer, has just been launched from Pembroke Dockyard. Her armament is to consist of four 67-ton guns, six 36 pounders, and eight 6-pounder rapid firing guns. If she is blessed with better luck than other Admiralty favorites have been of late years, she ought to prove a decided acquisition of utility to the British Navy.

THE TEHERAN RAILWAY.—Advices from the Caspian Sea announce that the railway from Resht to Teheran has been already begun, the Engineers are ready, and the material is beginning to arrive *via* Batoum and the Trans-Caucasian Railway. The enterprise, impatiently looked forward to both by the Shah and the Russian authorities, will be carried out rapidly. The laborers will be drawn from the south of Russia, and the men will proceed to Persia as soon as the Volga is open for navigation in the spring. Many Asiatics who were formerly employed in the construction of the Russian line as far as Merv have arrived in the yards, and are employed over the preliminary works. There is no present intention of carrying the line further, but plans have been drawn up for extending it to the east as far as Meshed, and to the south as far as the Persian Gulf. In the future it may even be extended to Herat and India. When once the section from Bakou to Resht is finished, a new route will be open to the Black Sea to India, and Batoum will acquire immense commercial importance. Although all these projects are yet a little visionary, they are favored by the Russian Government, and it is pretty certain that they will be realised by degrees.

MESSRS. KIRBY & CO., BOMBAY.—The Trustees of the Port of Bombay are pleased to record their extreme satisfaction at the manner in which the great work of Prince's Dock Extension has been carried out by the Contractors, Messrs. Kirby & Co. In several respects the amount of work done under the masonry and excavation contract has been greater than that tendered for, and yet, although the quality of the work is excellent, it has been carried out for less by Rs. 64,359 than the amount of the contract, and in eight months less than the time agreed upon, thus making the Victoria Dock available for use during a busy season earlier than had been anticipated—a very great advantage to the trade of the Port. Such results could only have been attained by the exercise on the part of the contractors of great skill and energy, combined with arrangements calculated to make the workmen contented, and with thoroughly cordial relations between the contractors and the Port Trust Engineers. The contractors have also to be congratulated on the small number of accidents, considering the nature of the work and the large number of work people employed. The satisfaction of the Trustees is increased by the fact that a member of the firm of contractors who carried out this great work is Mr. John Fleming, C.S.I., the Originator of the Elphinstone Reclamation on which the Dock is situated.

Current News.

THE Committee on the Railway Bill has nearly completed its work.

THE cost of the new Victoria Docks at Bombay is estimated at forty-three lakhs of rupees.

COLONEL PREJEVALSKY has, it is said, now decided to undertake a scientific expedition to Afghanistan.

THE question of retention or abolition of the Calcutta Mint has been decided in favor of that institution.

WE understand that much difficulty is experienced at the various Gold Mines in Kolar in the matter of obtaining fuel.

THE Government of Bengal intends spending a sum of Rs. 40,000 during the current year in improving Government estates.

A PROPOSAL for making a branch railway from Mysore to Narjengode is favorably entertained by the S. M. authorities.

PRACTICAL tests have shown that the leakage at the Malabar Hill reservoir amounts to a quarter of a million gallons per day.

WE learn on good authority, that the concession to construct a line of railway through the gold-fields of Kolar has been granted.

DR. NOETLING, of the Geological Survey of India, has been deputed to Upper Burma to report on the mineral resources of that country.

WE understand that the Survey Department has received instructions to push on the preparation of the maps of the Afghan Boundary Survey.

SOME stir is likely to be made about the cost of the London establishment of the Nizam's Guaranteed State Railway Company, which is something like £9,000 a year.

THE Government of India has declined to admit the claim of the Punjab Government to an assignment to Provincial Revenues of a share of the revenues of the Sidhna Canal.

ON the 1st April last a modified scheme was brought into operation by the Government of India for the collection and tabulation of the rail-borne trade statistics of India.

MR. KING hopes to secure a division in the House of Commons next week on the question of the Uncovenanted Service pensions. Some 80 members have promised him their support.

THERE is cholera at the Singareni Coalfields, and in fact all along the districts bordering the new line: the works are comparatively at a standstill owing to want of workmen.

THE preparation of a large scale map of Quetta and its environs is to be undertaken by the Survey of India Department, at the request of the Agent Governor-General in Baluchistan.

SEVERAL questions have been asked in Parliament about the concession to Mr. Streeter of the Ruby Mines. The Government contend that no binding contract has been made in the matter.

CARPET weaving, shawl weaving, ornamental pottery works are all being carried on successfully under the superintendence of Mr. Warner, in the workshops and manufactories inside Golconda Fort.

LAST year the number of recruits from Bengal and the North-West who entered Assam by way of Dhubri was 25,647, while the entire garden population is estimated at not less than 350,000 souls.

APPOINTMENTS in the Revenue Survey, which are now held by Uncovenanted Officers, are, a Madras paper understands, to continue to be treated as appointments open to Commissioned Military Officers.

AT the instance of the Government of India, the Map Department of the Board of Revenue, North-West Provinces, has been transferred to the charge of the Survey of India Department at Calcutta.

INTIMATION was received at Madras, on Saturday, the 26th ultimo, of the death, from malarious fever, at Bider, in the Ceded Districts, of Mr. John Conran, District Engineer in H. H. the Nizam's P. W. D.

THE authorities have taken notice of the defects in the Summer Palace of Tipu Sultan at Seringapatam, and hope that early measures will be adopted to put the building in thorough order before the wet season commences.

THE Madras Railway Company are substituting steel rails for the iron ones at present in use on this line. The steel rails have been introduced on certain parts of the line only, and will ere long be substituted throughout the North and South-West lines.

A VIOLENT gale of wind, accompanied by a thunderstorm, visited Lucknow last week. The artesian well, which, like that of Agra, seems destined to ill-luck, is said to have been the chief sufferer, the derick over the well having come to complete grief.

AT Ootacamund, on Monday afternoon, Lord Connemara opened the Adam Memorial Fountain, erected at a cost of Rs. 17,000, to the memory of the late Mr. Adam, Governor of Madras. The fountain was cast in Leeds, and is a fac-simile of the one in that town.

IN consequence, we believe, of the competition between the two Ice Manufacturing Companies on the Poonamallee Road, Madras, ice is now being sold in some parts of the city at the incredibly low price of one pie per pound, or twelve pounds for one anna.

A PRIZE of Rs. 100 has been offered by the Committee of the Soldiers' Industrial Exhibition, Bombay, for the best essay on "Practical Suggestions for the Clothing and Equipment of all Arms of the British Service during Peace and War at Home and in India."

PARTICULARS in connection with the recent storm at Cawnpore state that a good deal of damage was also done by it to the roofs of the buildings of some of the mills. In one case a corrugated iron roofing weighing three tons was blown to a distance of over 400 yards.

IT has been decided by the Government that no further expenditure is to be incurred on the Abdul Rahim Khan Canal in the Bannu District; that the capital outlay which amounted to Rs. 35,456 at the end of the official year 1886-87 should be struck off the books.

THE local Government has ordered that from and after the 1st of June instant, the highest rate at which Port dues shall be charged at any outport in the Madras Presidency shall be two annas a ton in the case of sea-going vessels other than coasting steamers, and three annas a ton in the case of coasting steamers.

LIEUTENANT J. H. S. MURRAY, Royal Engineers, is transferred from the Presidency and Oudh Command, Military Works, to the head-quarters of the Inspector-General of Military Works. Lieutenant W. J. D. Dundee, Royal Engineers, is posted to the Fort William Division, Presidency and Oudh Command, Military Works.

THE survey of the alternative route to Lundi Kotal from Jamrud through the country of the Mullagoris has been temporarily suspended owing to the illness of Mr. Baker, the Engineer entrusted with this difficult piece of work. He has now, however, recovered from the somewhat sharp attack of fever which prostrated him for a time.

WRITING on the subject of reform on Indian Railways, a contemporary asks the Director-General of Railways to issue a stringent prohibitory standing order against the continuance of the present objectionable system of overcrowding the railway carriages, and more especially the third-class ones, to the detriment of both the public health and comfort.

LIEUTENANT A. B. ROUGH, R.E., has been attached to the Presidency and Oudh Command, Military Works; Lieutenant G. A. Travers, R.E., has been transferred for duty to the head-quarters of the Inspector-General, Military Works; and Lieutenant S. L. Craster, R.E., has been transferred to the West of India Coast Defence Command.

THERE has been another attempt to wreck a train on the Great Indian Peninsula line, this time near Bir, a few stations this side of Khundwa. The engine and fourteen carriages filled with passengers were actually derailed, but no harm seems to have been done except to the permanent way. This is the third occurrence of the sort within the last fifteen months or so in the same neighbourhood.

IT is notified that in the case of Military Officers subject to Civil Rules, active service, for the purpose of calculating the amount of leave admissible under the Rules of this Code, commences from the date of first substantive appointment in the Civil Department, except in the case of an Officer of the Royal Engineers who was in civil employ on the 1st November 1886, and elected for continuous service in India, who counts active service from the date of his election.

Letters to the Editor.

[The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

SEYSSEL ASPHALTE.

SIR,—Will any of your numerous correspondents inform me if they have used the "Seyssel Asphalte" for floors $\frac{3}{4}$ " and 1" thick, and with what result (carried out as per instruction issued by the Seyssel Asphalte Company.)

W. GIRLING,
Assistant Engineer.

CALCUTTA; June 4, 1888.

JUSTICE.

SIR,—In yours of the 2nd. instant you allege that "local knowledge" is the ground on which Colonel Cumming becomes Chief Engineer of Burma and Mr. H. F. White is transferred to that Province from Hyderabad.

Allow me to point out that the claims of local officers with local knowledge were ignored when Major Gracey was transferred last year from Allahabad to Mandalay, for which there was not the slightest justification with such a man as Mr. Richards at that time in Mandalay, and Mr. White at Rangoon.

CIVIS.

THE MADRAS HARBOUR.

SIR,—Every one now-a-days seems inclined to say something against this harbour, and to censure the Engineers who designed and the authorities that sanctioned it. It seems to me that if all our heads were laid together in consultation, some plan might be hit upon to successfully resist the mighty ocean power that has to be contended against at Madras. The Colombo breakwater is a success, but I fancy there must be a greater power at work on the Madras shore than there is in Ceylon. To the best of my belief the breakwater at Alexandria was formed by letting fall into the sea huge blocks of stone or concrete and they were allowed to lie where they lay and were not packed close together like sardines in a tin. The result is that the destroying wave falls on that breakwater and its force is broken there; but a great deal of the energy is expended in getting through the interstices in the construction. Taking this as an hypothesis it is proposed to so construct the breakwater at Madras that the force of the water may not all be expended on the wall, but by leaving holes in it a very large amount of energy will be wasted in getting through these inlets. At present the whole momentum of the wave is used up on the breakwater, but if holes—circular in section—were made during the construction of the beton blocks, I presume to think the construction would not be materially weakened and that an outlet would so be formed for some of the force of the wave. It may be objected that the huge concrete blocks would be very seriously weakened by this plan, and that the rush of water through would very quickly destroy the artificial rock. This is indeed very possible, and to meet that contingency I propose to form the holes in question with cast-iron pipes which will be set in the concrete at the time of making the blocks. The end against which the wave would break could be cast bell-shaped. These castings could be landed in Madras for £5 a ton and I think would serve to keep the breakwater standing. If some of your numerous readers will show how this plan would fail or support the method and improve on it, I shall be much obliged.

DAMOOKDIA, E. B. S. R.;

June 3, 1888.

A. H. MASON,
Executive Engineer.

MADRAS WATER-SUPPLY.

SIR,—I beg to offer some suggestions with the view of improving the water-supply of the capital of the Southern Presidency.

Madras is supplied with water from the Red Hills tank, which is fed by a channel from the river Kortalaray which passes through a reserved reservoir known as the Sholeveram tank before it arrives at the Red Hills, from whence it is conveyed through the Municipal sluice pipes down an open channel to Madras. The drainage area of the two tanks, including that of Busikal and Kattankal, together with that portion of the river between the Thumierapauk anicut and Kasarveram dam, is 928 square miles.

The capacity of the two reservoirs when full are 2,000 and 578 million cubic feet, respectively, or together 2,578 million cubic feet.

In Mr. Frazer's original scheme it was intended to pump water from a low level bed, but the Municipality to avoid the cost of pumping preferred to adopt the principle of gravitation; this was an advantage gained at a sacrifice of quantity (and I might here add of quality), the water having to be drawn off the Red Hills at a level of 6 feet higher than that intended. The lowest level of Municipal sluice being 31.31 above M. S. L. and that of the crest of weir 43.31, and the area of the Red Hills tank being 7 square miles,

the water available is the difference between 31.31 and 43.31, or 12 feet over an area of 7 square miles.

When the water falls below the level of the lowest pipe, a channel is cut in the bed of a tank leading to the Municipal sluice, where three engines with centrifugal pumps are placed and the water pumped into the off-take channel. The channel in the bed being shallow the force of the pumps makes the water muddy and this water passing into the pipes coats them with liquid mud, hence one cause for the water being considered impure.

Mr. Jones' scheme for improving the quality and quantity of water for Madras, is to pass the water under the bund of the tank by means of pipes at a level of 21 M. S. L. and from there to pump it into filtering beds, from whence it is to be conveyed in pipes to Madras. The estimated cost of this scheme is 12 lakhs of rupees.

From the above it will be noted that the drainage area is 928 square miles and the rainfall of this area is 38 inches. This represents 82,041 million cubic feet; taking half the above as the actual quantity drained into the tanks, and 626 million feet as the loss by evaporation during the year, the remaining 40,394 million cubic feet is more than sufficient by 37,816 million to fill the two reservoirs. This immense quantity is lost, owing to the capacity of the tanks being insufficient. The raising of the crest of the two weirs having proved disastrous in December 1884, Government is not likely to repeat the operation.

Mr. Jones' scheme is no doubt a good one, but it will not prevent this great waste of water, and will give Madras a plentiful supply at the expense of the ryots, which means a loss of revenue, besides the enormous debt which will be thrown on the rate-payers.

It having been found necessary to resort to pumping, I would suggest for the consideration of the Municipal Commissioners the improving of Spur Tank which, being in the town of Madras, would save the cost of laying a double line of pipes 7 miles long, and by supplying the tank with water from the Red Hills, another reservoir is added to the two already mentioned. Here let the Municipality erect a pumping station with filtering beds below the tank, and with a hundred horse-power engine the whole of Madras could be supplied with a plentiful supply of wholesome drinking water during the whole year at a cost of less than half that proposed, leaving ample for irrigation purposes.

J. K.

BANGALORE WATER-SUPPLY.

SIR,—In its issue of the 26th May the *Madras Times* devotes its leader to a consideration of General Fisher's project for the supply of Bangalore with drinking water, and thinks it "Rather hard on General Fisher" that the British Resident of Mysore prohibited any expenditure on the investigation of this scheme, till the decision of the Madras Government was known.

It will be in the recollection of all interested in Indian Engineering that the Madras Government very wisely endeavoured to obtain the best possible advice regarding the means for supplying Bangalore with water by calling for prize essays on the subject. The premium offered was liberal and sufficient to attract the best professional knowledge of this country, official and non-official.

These essays were to have been submitted by the 15th May. For the Bangalore Municipality to take up the first one sent in, and to spend money on its investigation, would be manifestly premature and unwise, if not unfair to the other essayists, unless the Municipality had made up its mind to treat all in a similar manner.

If Rs. 500 were granted to General Fisher to demonstrate the practicability of his scheme, every other essayist might demand a similar indulgence. So that the Resident was quite right in vetoing the first step in this system of useless expenditure. If he allowed it in General Fisher's case, and withheld it to others, would not there be a cry of "unfairness" howled out at them from all directions? Or if it was granted alike to all, would not the public rightly complain about the useless expenditure?

The *Madras Times* further states that "the project was communicated to the Viceroy," who stated that "the attention of the Madras Government was drawn to it." Putting this together with the attempt to get the Bangalore Municipality to allot money for its investigation, and thus in a manner to commit themselves to the scheme, does it not appear as if General Fisher or his friends are trying to "rush" his scheme before the receipt of the projects of the other essayists? What is this for? May not some suppose that they are afraid of the competition? If the General is the strong Engineer the *Times* makes him to appear, this will hardly be the action one would expect in a public competition. If in ordinary business transactions "Quietness and Confidence" is supposed to denote "Strength," much more so should this be the case in a public competition. Does the General suppose that the halo of the Viceroy's approval, or being "a colleague of Sir Arthur Cotton," as the *Times* puts it, is going to over-awe the judges. If his project has all the merits he claims for it, let it lie patiently on that firm foundation, and no doubt the good and true men who are to be the judges, will recognize this, but the premature puffing and blowing from Viceroy, to Municipality, and *Madras Times*, are only evident signs of weakness

somewhere, as none of these are Engineers qualified to give an opinion on a very intricate Engineering question.

If with the aid of all this outside influence, it was intended to carry the General's scheme by a sort of *coup d'état* Boulangerism in a small way, then the Resident's well timed fairness has made the attempt a miserable failure, and Mysore should be congratulated that it has got so firm a hand at the head of its affairs. Sir Harry Prendergast being an old R. E. himself would have had natural leanings to the project of a brother R. E., and that he has not allowed this to influence his actions, is another healthy sign that all the projects sent up will be carefully weighed in the balances, and those found wanting unceremoniously rejected without fear or favor. I do not know how many or what are the projects submitted, and if even I did, I would refrain from criticising them while yet under consideration; but a glance at the map will shew that Bangalore is situated on an undulating ridge, sloping away in all directions, so that any project for storing water in a reservoir below the town, on whatever side, must get more or less affected by percolation of the town sewage, which by the law of gravity must always flow downwards. It was for this reason that both the Ulsoor and Agram reservoirs were condemned, and there will be the same objection to storing water in any other direction below the town. With this general remark affecting probably all the projects submitted I will leave this subject for the present.

ONE WHO KNOWS.

THE USE AND ABUSE OF IRRIGATION.

SIR,—The questions as to what extent irrigation is beneficial, and to what extent detrimental to the people where irrigation is practised from wells, wheels, reservoirs, rivers and canals, will always remain unanswered until enquiries are made on some systematic basis and measures adopted to continue enquiries for a number of years by a series of comparative experiments. In ordinary civilised countries, questions of this description would be considered part and parcel of the department which has been the cause of bringing prominently to notice the destruction to life and property by excessive irrigation. The department knew and felt that eventually the evil day would arrive, but tenure of office-holders like every other department in India is but of a temporary nature, the consequence of this state of affairs is to run the routine of office in the same old grooves, and allow all vital matters which would take time to investigate to settle themselves, and the officer who lays himself out for the study of tactics for keeping the superficial liquids of office routine clear and up to date, is certain to gain credit for administrative ability, but the officer who seeks true progress by the natural law of antagonism is shunned and considered a nuisance. Good laws for the regulation of canals have been passed, bye-laws invented, clearly pointing to one policy, but those learned in law have stepped in, and the problem of keeping the liquid clear is daily becoming more difficult in the hands of the skilled administrator, who, when to save his credit, can always avail himself of furlough. The laws and bye-laws are used by the inferior establishment for extortion and fraud, and the people themselves fraternize with the inferior officers and sell and use canal water illicitly; the loss to Government by frauds being estimated annually at some 50 per cent. of revenue, and as a consolation for this loss the department produce the feeble statement that several famines have been prevented, and therefore indirect gain to the Government. Illicit irrigation is the cause of the canker called excessive irrigation. Once completely put a stop to illicit irrigation the battle against destruction to life and property would be more than half won. Illicit irrigation has been the cause of the production of bunds made by the people, sometimes stretching from one canal to another for the storage of canal water; these bunds since the introduction of canals have been re-built on the lines of old and disused ones, but the robbery of canal water pays so well that these bunds are now kept in the most efficient state of repairs, and their height in many instances has been raised several feet beyond any previous known height, when they were solely dependent on rain supply or spills of rivers. These bunds besides cross all the drainages of the district, and when they become overcharged by rainfall or by the interruption of canal water running to waste, in every instance an escape can be made into the temporary cuttings of canals, or into reaches of distributaries through "outlets" fixed in the canal banks for distribution of water, and it is a fact that these bunds are only kept in repair where the land is fully commanded by canals. When canals were first started, it was expected that these bunds would fall into disuse, and no doubt they would do so now if robbery of water could be stopped, and the people made to understand that laws and bye-laws stood but one interpretation.

The remedy which is sought for this state of affairs is a water-meter, or in other words a mechanical supervisor. An efficient mechanical supervisor would be worth a large sum of money to the Government, and as the problem to solve is on a par with that of perpetual motion, the Government might with safety offer a very large sum for the production of an efficient machine, but in the meantime it is clearly the duty of the Government to at once increase its superior establishment of trustworthy and intelligent officers to the extent necessary to completely stop all illicit irrigation. All canal officers should be at once relieved of judicial work, and an establishment of Deputy Collectors appointed for judicial

investigation and settlement of complaints resulting from assessment made by canal officers. Deputy Collectors and all canal officers should be independent of the Collector and Superintending Engineer of the district. Appeals to be allowed only to a law officer attached to the Office of the Secretary in the P. W. D. Irrigation Branch.

The want of powerful efficient superior supervision is inducing the people to consider the fraudulent use of water as part of one of their legal rights, thereby leading them to their own destruction, and causing the ruination of a beautiful system for the utilization of water which before ran to waste. This state of affairs might be easily rectified by the expenditure on superior establishment of even only a portion of the amount now known to be lost annually to Government by illicit irrigation; famines would still be unknown, but the direct and lasting gain to the people by the prevention of illicit irrigation would be incalculable.

SPERO MELIORA.

Literary Notices.

ARMY PRELIMINARY EXAMINATION PAPERS. 1882-87. London: Macmillan and Co. 1888.

THIS little book contains specimens of papers set at the Army Preliminary Examination during the last six years, with answers to the Mathematical Questions. The subjects include Arithmetic, Algebra, Euclid, Geometrical Drawing, Geography, French, and English Dictation. We are disposed to think that the book will be found of use in many European Schools in India, since the exercises it contains embrace the course of study in many of them, and might even be advantageously used in the Entrance Preparatory Classes of the Indian Universities.

COMPANION TO THE WEEKLY PROBLEM PAPERS. By the Rev. John J. Milne, M.A., St John's College, Cambridge. London: Macmillan & Co. 1888.

THIS book is intended for the use of students preparing for Mathematical Scholarships and for junior members of the Universities who are reading for mathematical honors. It is a sequel to the author's WEEKLY PROBLEM PAPERS, and their SOLUTIONS, which we have not seen. But the book may be read independently by itself with profit. The work is not a continuous treatise on any one subject, but is made up of a series of articles written by the author or his friends intended to illustrate the recent developments in Elementary Mathematics and make them available for the purposes of the student.

The Theory of "Maximum and Minimum" and of "Envelopes" is discussed algebraically, and geometrically, and the intimate relation shewn to exist between both subjects. The author has not had the advantage of consulting Ramachandra's *Maxima and Minima* by De Morgan, a work which attracted much attention about twenty years back, and which has never met with the publicity it deserved.

Article III. treats of the "Application of the Property of the Centroid to Geometry." For the information of some of our readers we may say, that the term "centroid" is the modern and compact substitute for "centre of gravity." The theory of the centroid affords much illustration and confirmation of simple geometrical properties, and a certain harmony in this respect can be established between Statics and Geometry which is the object of the article.

The article on "Biangular Co-ordinates" contains matter that is both novel and interesting, and the Chapters on "Recent Geometry" in the article that follows, are particularly rich in the new triangular geometry, the study of which up to lately had been entirely confined to the Continent, and the nomenclature is in conformity with that generally adopted by French writers.

Space precludes us from noticing the other articles of the volume. They are as interesting as those referred to, but we may add that the examples solved throughout the work with the University Examination Papers at the end of it, ought to make the "Companion" what it professes to be; and we may add that it is one of the best introductions to elementary modern pure mathematics as yet published in the English language.

General Articles.

THE BETWA CANAL, NORTH-WEST PROVINCES.

II.

THE ENGINEERING AND REVENUE POINTS.

THE interesting Engineering points in connection with the Betwa Canal are—

- (a). Weir across the river.
- (b). Canal head and scouring sluices.
- (c). The head reach in deep digging.

Unfortunately the plans of the canal head and sluices are not very clear and there is not a single description or drawing of the regulating gear. The regulating gear is said to work satisfactorily, though it is by no means an easy task to regulate with a head of 40 feet.

Departmental proposals about head works and criticisms thereon in the first rough project of 1868 are given in the following extracts:—

The canal starts from a point on the river near the village of Pureecha, where a convenient site for a weir has been selected. The bed of the river at this point consists entirely of rock, its banks are of fairly firm soil, and its course is straight. The rocky bed forms of itself a natural weir, and it is proposed to raise the surface of the water by means of an artificial weir of masonry in line, to within 3 feet of the highest point of the section of the river bed at site of dam (*i.e.*, to R. L. 622'66); in addition to this, 3 feet of planking would be added when the river is low, bringing the water surface to a level with the highest point of the section (R. L. 625'66). The river banks on either side would be protected with retaining walls, for which rock foundations can be obtained in the bed of the river. The regulating head would be on the left bank, connected with the retaining walls. The discharge of the Betwa in highest flood, as calculated from the flood sections taken is 714,904 cubic feet per second; the length of the sill of weir would be 2,426 feet; the flood-level would be raised 7 feet by the construction of the weir (or to R. L. 652'67), which would bring it 0'81 feet above the right, and 2'01 feet above the left bank; a small embankment would therefore be necessary to prevent the floods turning the weir on the right bank, or getting into the canal on the left bank. In calculating the afflux, the velocity of approach has, for safety's sake, not been taken into consideration, otherwise the afflux would be reduced by 1 foot. The velocity of flood passing over the weir is 11'12 feet per second, which, considering the nature of the bed, is not excessive.

It is proposed to give a maximum depth of water in the canal at the head of 8'25 feet; the reduced level of the regulating head has been fixed at 617'16 or 5'50 feet below top of planking of weir; this would give a slight head of water into the canal of 0'25 feet. The depth of digging for the first 7 miles being considerable, it has been considered advisable to give a good depth of water, and a moderate slope to the bed (0'82 feet per mile), so as to reduce the sectional area of the digging. These calculations have been made on the supposition that the maximum supply during the khurreef would be 1,000 cubic feet per second, and are of course liable to correction as soon as the actual culturable and irrigable areas have been ascertained. The slope of bed has been fixed after several trials, and gives about the cheapest result, for if it were reduced, either the width of bed or the depth of water would have to be increased; the former would add to the sectional area of digging, and the latter would necessitate lowering the regulator head, as the weir could not well be raised higher.

As to this matter Colonel Greathed, Chief Engineer, remarks:—

Lieutenant Home's report shews that the only means by which rubbee irrigation can at present be obtained from Betwa is by forming a weir across the river, proposed to be 27 feet above bed in lowest part of section, and 19 feet above cold weather (April or minimum)

level of water in the river. The cross section of river is very uneven, the deepest portion is only 60 feet wide, and owing to the natural rock rising in a great part of the section of the river to the level of sill of proposed weir, the amount of masonry in such a weir would be much less than would be expected from the statement that it is proposed to put a dam 27 feet high, across a river 2,300 feet wide, which in the monsoon is a raging torrent, carrying 715,000 cubic feet of water per second to absolute waste.

His sections shew that after 7 miles of deep, but not prohibitive digging, water can be brought to the surface of the country, whose only disadvantage thenceforward in an irrigating sense is that its slope is so rapid as to require frequent falls, and so considerable a slope of canal bed as to render navigation impracticable, which is a great misfortune. The natural slope of the country upon the proposed central canal is 197 feet in 70 miles, or 2'7 feet per mile.

Notwithstanding our limited space we cannot help quoting nearly the whole of Colonel Strachey's note:—

The Betwa Project is comparatively simple. The only difficulty is how to get out of the river. The sketch sent up shews rather heavy digging for 4 or 5 miles, but nothing impracticable, and so far as I can judge, a great deal of this might be avoided, as I shall explain presently. The dam does not seem to be formidable, and I should not think that there was any risk in its construction. Colonel Fife has built a dam of 22 feet fair fall on a river in the Deccan, and it stands quite well. There is a subsidiary low dam wall of 7 feet a short distance below to break the water, and some such plan could of course be followed here.

The Betwa floods seem to rise some 40 feet or so, and a special arrangement would be necessary for shutting them out of the canal, but in this there would be no difficulty.

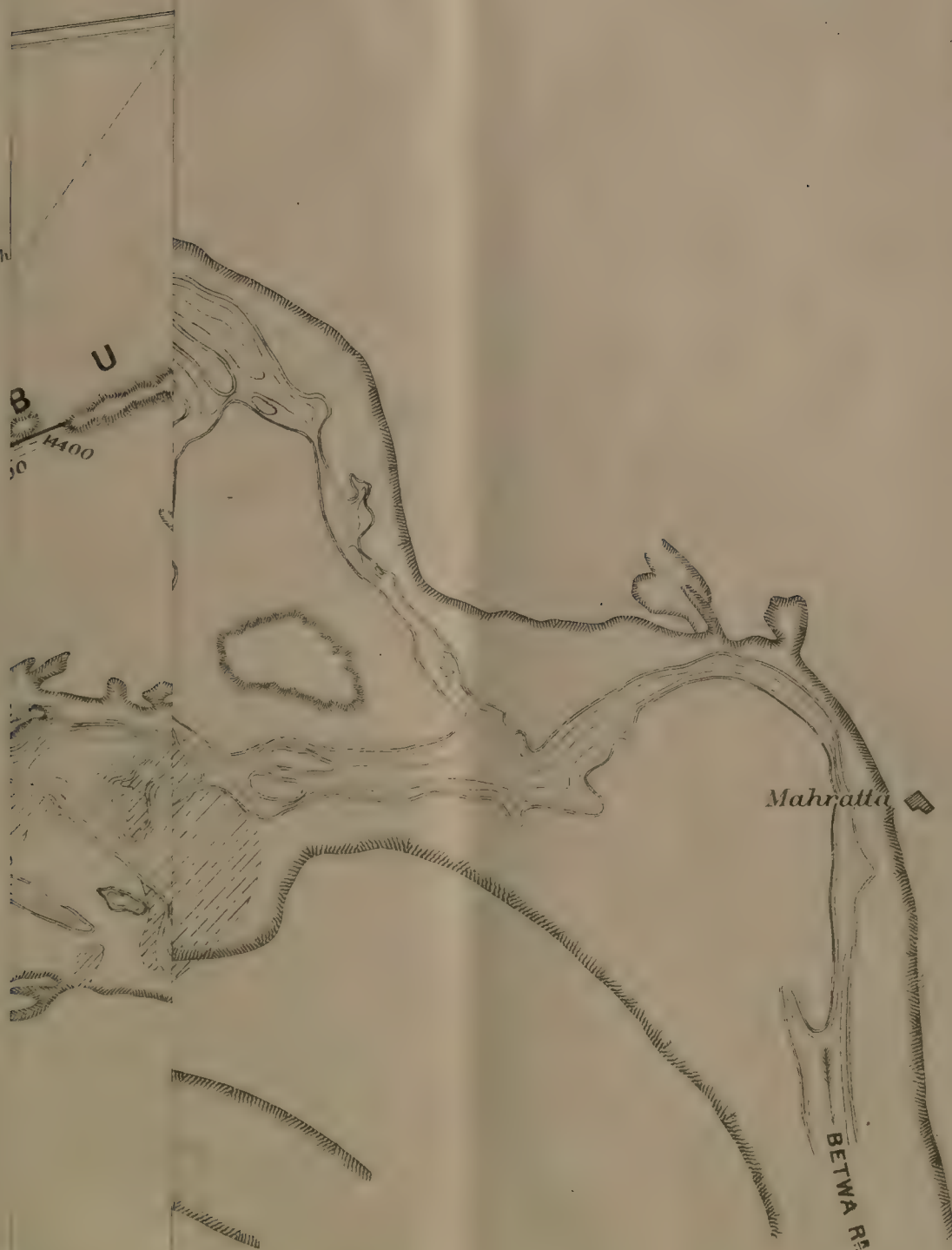
Nor do I follow what is said about the rubbee cultivation from such works as are proposed. We have quite sufficient evidence to shew that there will be a fair body of water passing down the Betwa during October and November, sufficient at all events to give absolute certainty to the sowing of the rubbee, and that the supply will continue so as to give some help to the crops even as late as March. It is quite certain, moreover, that if arrangements can be made for storing water above the dam in sufficient quantity to give a full rubbee supply for the whole area commanded, the water must be distributed through the same canals that deliver the khurreef water, and in fact that the stored water must be thrown into the Betwa and taken up at the dam.

Therefore it seems to me, that there can be no sort of question that some such scheme as is sketched out by Lieutenant Home, will be the only means by which irrigation can be given to the districts under consideration, and that there need be no hesitation whatever in working out the project at once in detail, and proceeding to execute it, unless the cost should be far more heavy than I anticipate. The investigations into the possibility of a full rubbee supply may of course be properly put in hand as early as practicable, but it would be most objectionable to delay the maturing of the project for the Khurreef Canal for any such purpose.

Neither am I very certain whether I should not prefer to have the Khurreef Canal in actual operation before attempting to deal finally with a stored supply of water to supplement the rubbee cultivation. I have no doubt that what I call a Khurreef Canal will practically save the country from famine, and I have not perfect confidence in our being able to store water in the manner in which it must be done in this case to give what we want in an economical way. I think with our limited Engineer power that we may best do at once, and as speedily as possible, what we know that we can do certainly, and unless the available strength of Engineers is much more than I anticipate, I should distinct

FURLONGS

new road from the



S^r R.W.L. HAWKINS

Executive Engineer

B. C. Division 20.8.86.

ly oppose any immediate investigation into the Upper Betwa during the next season at least.

I have already stated my conviction that the extreme North-West view of refusing irrigation, unless a *permanent full* rubbee supply be given, is a grave mistake, and I regret to see that the Minute of the Lieutenant-Governor of the North-Western Provinces seems to take this view in the present case. The 3rd paragraph does not reject absolutely the sort of scheme which could at once be carried out from the Betwa; but it seems to imply that the Lieutenant-Governor would prefer to have nothing done till the Engineers have tried to get a permanent water-supply for the whole tract to be irrigated, and have either succeeded, or finally shewn that it is impossible. I cannot too plainly declare my own convictions to be quite opposed to this course, and I trust that on further consideration it will not be pursued; but that immediate measures should be taken for maturing the design for a canal, which will at all events give complete khurreef irrigation to a large area, and which will be perfectly suited for the distribution of a rubbee supply if hereafter the means should be found for obtaining it.

The experience of the present year seems to be sufficient to shew that the real apprehension of serious danger arose from anticipated failure of the September and October rains. As soon as the late rain fell, every one declared himself easy. Such a canal as we can with *perfect certainty* set about at once from the Betwa, will do much more than give the equivalent of a good September rainfall. My belief is, that in 19 years out of 20, it would give such protection to the rubbee as to secure a moderate crop, though of course the greatly superior advantage of the thorough irrigation that would be got by a full cold weather supply is not disputed.

To think that when a satisfactory supply of water is available, the khurreef crop is likely to be altogether secondary, also seems to me a delusion. In Bundelkhand particularly, I believe that rice cultivation will greatly expand on an abundant khurreef supply. There is no solid ground for Sir W. Muir's apprehensions that black soil may be unfit for irrigation. There has been abundant experience on the subject in Madras and Bombay to remove all cause of fear as to this soil being unsuitable for artificial irrigation in any sense, either as regards the agriculture, or the fitness of the soil for embankments or channels. So far from its being bad, it is very retentive, and so long as it is kept moist, which channels in use always would be, there is no disposition to crack.

On the subject of the value of khurreef irrigation, it is worthy of remark that at the present time the irrigated area on the Western Jumna Canals is as nearly as may be equally divided between the rubbee and khurreef. I am not at all disposed to take Colonel Rundall's extreme view, that the khurreef crops are likely to displace the rubbee in Northern India at least, but I see no sort of reason why the natural capacity of the soil should not be as fully utilized in the khurreef with tropical products, as in the rubbee with temperate ones.

Returning to the project as it is roughly sketched by Lieutenant Home, I would remark that the levels indicate that there will not be much gained by bringing the water to the surface at a higher level than 585, which is at a point near the town of Mote. Above this the fall is great, and the space between the Betwa and Pahooj, which rivers practically limit the area irrigable, is narrow. Now this point of 585 feet level is about 16 miles from the proposed head, and in this distance falls aggregating 21½ feet have been introduced in the canal channel to overcome excessive slope. The natural inference would be, that the canal bed level should be worked back from the 16th mile, when the canal bottom is, say, 581 feet with a proper slope until the river is reached. So far as I can see from the levels shewn on the map, there is nothing to prevent this being done. The project shews the level of the canal bed at the dam as 617. The *necessary* level to lead to the level of 581 at the 16th mile

would be 595.5, so that the water is taken off about 21½ feet higher than is essential. The difference might be made up either by reducing the height of the dam, or by taking a point lower down the river to start from. This part of the project should be revised at once I think.

I would add that I see no objection, if it be more convenient or economical to carrying the canal channel within the bed of the river, so as to be wholly submerged in extreme floods. All that would be necessary would be to have a proper regulating work at that point on the canal where it finally left the river bed.

E. A. S.

LIMES AND CEMENTS.

FAT lime, poor, slightly, highly and eminently hydraulic limes are terms well known to every Engineer; but I think a few notes carefully culled, and as carefully dished up as possible, will be of interest, and may give rise to some interesting and valuable correspondence. There are many bits of useful information to be extracted from numerous correspondents and I shall be only too glad to be corrected when on the wrong track. A fat lime is the product of calcining and slaking a pure carbonate of lime. Now this pure carbonate consists of fat or pure lime in chemical combination with carbonic acid and water. The burning operation drives off these two latter and leaves quick or caustic lime. When water is added in sufficient quantity to this quicklime it swells rapidly to two or three times its original bulk, disintegrates completely, gets very hot indeed and becomes slaked lime. This speedy alteration from caustic to slaked, this great increase of bulk and heat and complete disintegration, are all powerful witnesses to the lime used being a fat one, and this is a most important thing to note, as fat limes for ordinary mortar are not a desideratum if hydraulic limes are to be obtained, excepting as hereafter mentioned. This fat lime, in order to be of use as a mortar, has either to regain the carbonic acid it lost in the burning or enter into some new combination with silica, alumina, &c., forming silicates and aluminates of lime or a compound of both of these. Now silica to unite with lime requires great heat, and alumina to do the same thing wants still more, hence the fat lime to become mortar must trust chiefly to obtaining carbonic acid from the air, unless indeed we can find anything else in nature that will combine with the fat lime and form a fairly hard mortar. Pozzuolanas have this power, and the soorkee of this country is a pozzuolana. This shall be treated of further on after discussing fat lime mixed with sand to form mortar. This should never be done for works where immediate strength is required. If one could afford to wait a hundred years or so, and could ensure the free access of air to every portion of mortar, then it might be possible after a century to reproduce in the mortar something of the hardness of the original pure carbonate from which the fat lime was formed. Let us make a mortar of, say, two good clean pit sand and one of fat lime, both by measure; the lime gets round the particles of sand and offers a better entry for the air to the inside of a wall and the lime sticks better to the sand than to itself, and the air contains a very small quantity of carbonic acid, and this small amount the lime has a great affinity for and takes to itself and the mortar does set hard by this means after a long time. This action however only goes on for about half an inch into the interior of the wall, and the inside mortar, having no access to the air, remains soft. Sand and fat lime mixed form only a mechanical mixture; there is no chemical combination, excepting one so minute as only to be traceable in mortars whose age is counted by centuries.

Fat lime mixed with water dissolves gradually in the water, and if the water be changed sufficiently often, the whole of the fat lime will disappear. Make a mortar of fat lime and sand and keep it under water and it will remain soft always. Hence one is brought to think that fat limes should never be used in admixture with sand, excepting in positions where the air has free access to the mixture. Such a case occurs when sand and fat

lime are used for plaster on walls and even then a little pozzuolana or soorkee would be of service. It is a common saying among the wise, that the present generation cannot make mortar like our ancestors did, but I venture to think carbonic acid, gradually supplied, and silicates of lime very slowly formed, give the answer to this belief. Hence we conclude that it is only after excessively long periods of time that mortars made of fat lime and sand can harden, and so the maxim should hold: Don't use them, where and when you can possibly avoid doing so. Fat lime can, however, by mixing it intimately with a sufficient quantity of clay, i.e., to imitate an eminently hydraulic limestone—and then burning the mixture over again—be of great use in making a serviceable hydraulic lime. Chalk can be pounded—without being burnt—and mixed at once with a suitable amount of clay. This being reburnt would have great hydraulic powers. Fat lime can also, when intimately incorporated with pozzuolana, be made to produce a good hydraulic mortar. A fair instance of this is Sylhet lime mixed with soorkee. An analysis of Sylhet lime is not obtainable here just now, but it is certainly either a fat or a poor lime, which latter may be described as carbonate of lime mixed with a small amount of useless and inert impurities such as sand, which form only a mechanical mixture with the carbonate of lime. It has been said before that silica by itself can only mix chemically with lime in the presence of great heat. This is true, but the compounds of silica, alumina, &c., such as are formed in the burning of clay, unite more or less quickly with fat and other limes in the presence of water. The water dissolves the lime and brings it and the compounds of silica and alumina into intimate connection and so tends to form that mixture of compound silicates of lime and aluminates of lime which have the power of setting under water. When iron, potash and soda are found in the clay, these help the formation of favorable compounds of silica and alumina under the action of less heat. There is generally a little soda or potash, or compounds of potassium and sodium, and a little iron in every clay, so that an excessive amount of heat is not always necessary. The amount of burning of a clay to produce a good artificial pozzuolana or soorkee depends upon the composition of this clay. If it be rich in iron and alkaline earths, then only a slight calcination is necessary. This accounts for some Engineers writing in their specifications that the soorkee be made of under-burnt bricks. Such a specification recently was printed in INDIAN ENGINEERING. Thus it is seen that if lime, even when fat, can come into intimate connection with compounds of alumina and silica, it will form a hard setting mortar; and as water takes solutions of lime and silicates and helps their thorough and intimate admixture, one sees the necessity of keeping abundance of water on all hydraulic mortars. Masonry made with such a mortar should be kept wet for a month after completion. This, of course, explains the reason why bricks or stones used in masonry should be as full of water as possible before being used. Such a mortar as has been now spoken of should be made fresh and fresh, and when possible with newly slaked lime. Caustic lime made from pure carbonates of lime can be slaked slowly by allowing it to absorb moisture from the air. For the mortar to be good it is absolutely necessary that every particle of lime shall come into intimate admixture with a certain amount of the artificial pozzuolana or soorkee. This thorough incorporation can only be effected by the use of mortar pans and mills; or some other mechanical contrivance, or by a vast amount of manual labor. The proportion of soorkee to be used will depend on its nature and is best ascertained by experiment. Briquettes should be carefully made with different mixtures, allowed to form a thin hard coat by keeping in air for, say, six hours in this country, and then completely submerged in water. Their respective strengths could be tested from time to time.

(To be continued.)

PRINTER'S OFFICE, LAWRENCE ASYLUM PRESS, MADRAS.

THIS building is an addition to the well-known group on the Mount Road, and has been erected to meet the requirements of the increasing business of the Press. It is two storied: the ground floor accommodating printing presses, while compositors are accommodated on the upper floor. Communication between the two floors is provided by means of stairs at each end. There are also two lifts for passing set-up type between the two floors. The ground floor is paved with granite slabs, while the upper is of teak boarding laid on joists supported by a row of elegant cast-iron columns imported specially for the purpose.

A novel feature in the building is the roof, of which we give an illustration. The Directors desired to have plenty of light and ventilation: this was secured for them by their architect by the contrivance of running up the queen posts of the trusses 2' 8" above the straining beams, and introducing swinging ventilators between them. The ventilators on the east side are glazed, while those on the west are panelled. The roof is lined with $\frac{3}{4}$ " teak boarding throughout, and is tiled on the sloping portions, and covered with terracing on the flat portion between the queen posts. Each queen post is double, being made up of two pieces each 6" x 3"; they are checked into the tie beams, which are 10" x 5", $\frac{1}{2}$ " in each, the distance between them being thus reduced to 3"; they have packing pieces where bolts go through them, and at their upper ends. The roof has hipped ends, the hip rafters being seated on dragon beams framed into angle ties. The end bearers are seated on wall plates and checked into the straining sills in the usual way; and the end rafters and hip rafters are framed into cleats 3' thick on the queen posts at their upper ends. These cleats are part of the queen posts themselves, being cut out of the one piece of timber 6" x 6". The span is 30' clear; and the trusses, which are seated on continuous wall plates, are 10' apart centre to centre. The tie beams, which are 33' 6" in length, are in one piece. Teak alone has been used.

The building was designed and erected by Mr. R. W. Thompson, C.E.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK. XXXIII.

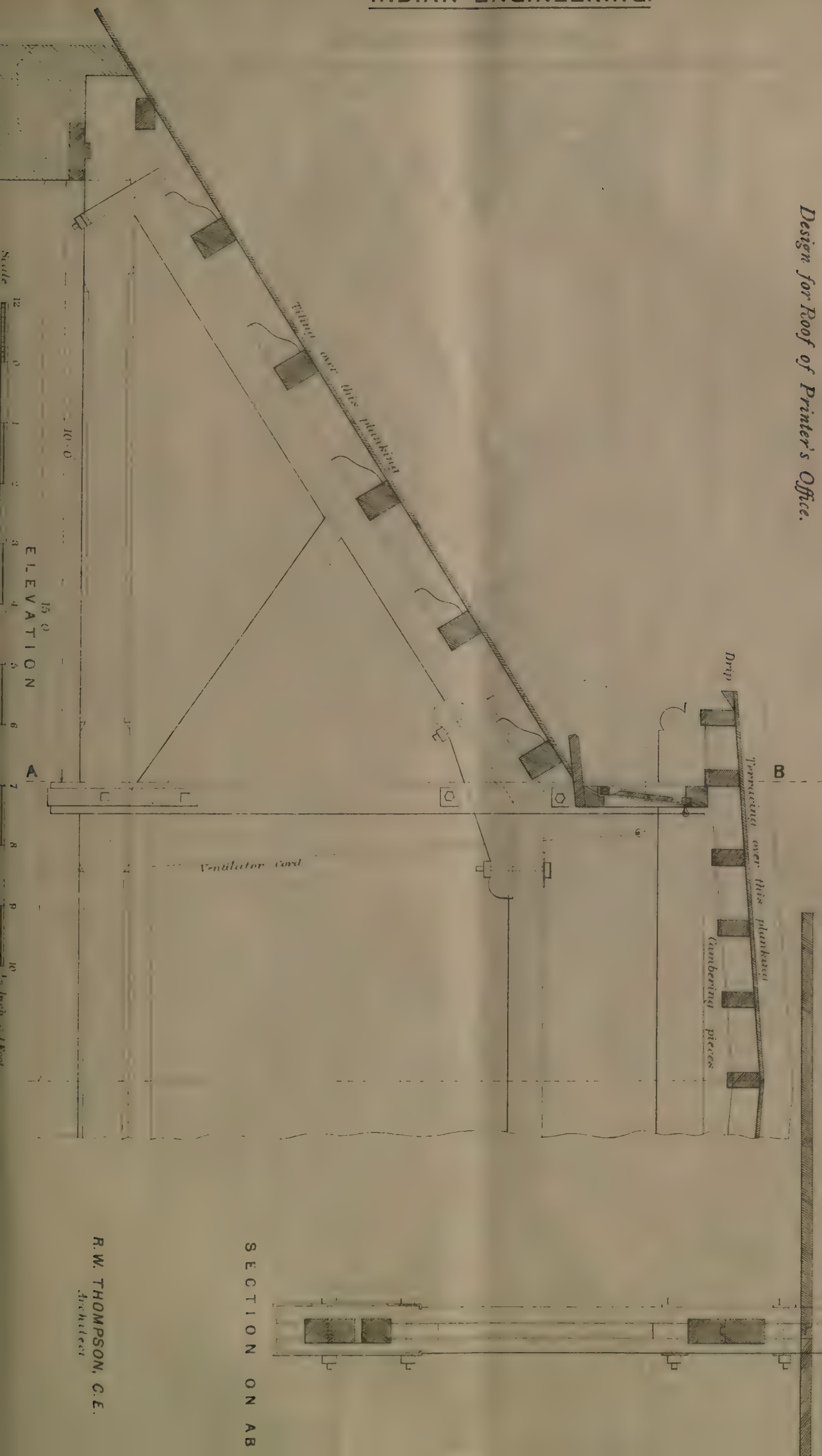
GLAZED windows, $1\frac{1}{2}$ " thick framing.

Items for a window 5' x 4' = 20 s. ft.	No. or Quantity.	Rate.	Amount.	Total.
(1)	(2)	(3)	(4)	(5)
Labor.—				
Carpenters No. ...	5			
Coolies " ...	1			
Sundries " ...	...		
Materials.—				
Teak scantling including waste c. ft. ...	14	Variable.	Do.	Do.
Panes of glass No. ...	24			
Butt hinges 4" pr. ...	4			
Tower bolts 9" No. ...	1			
Do. 12" " ...	1			
Screws 1" doz. ...	2			
Do. 1 $\frac{1}{2}$ " " ...	3			
Hold-back hooks No. ...	2			
Sundries ...	...		
Petty Establishment ...	...		
Total per 20 s. ft. ...	...		
and per Supl. ft. ...	...		

THE course to be followed by the proposed Siberian Railway has now been finally mapped out. The line, when completed, will run from Tomsk in the west to Vladivostok on the Pacific coast, and connect the following intermediate places:—Marjinsk, Atchinsk, Krasnojarsk, Nijni Oudinsk, Irkutsk, Posolskoi, Verkne Oudinsk, Chita, Nertchinsk, Sretensk, Grafskiport, and Nikolskoi.

LAWRENCE ASYLUM PRESS,
MADRAS.

Design for Roof of Printer's Office.



SECTION ON AB

R. W. THOMPSON, C. E.
Architect

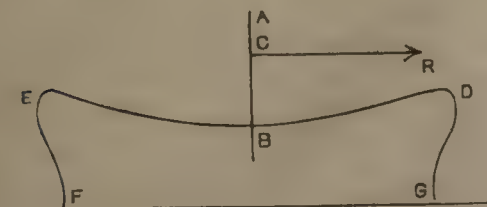
PROPERTIES OF FLUIDS.

BY A. EWBANK.

XV.

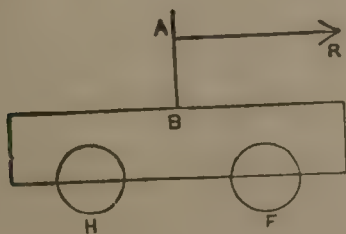
LET a ship be sailing on what we have considered as the simplest case, *viz.* with the wind right aft or exactly astern and the sails set square or athwartships. Then the ship moves in the direction of the wind. But there is one peculiarity about her movement, she has a perpetual tendency to pitch or to dip her bows in the water. She does in fact dip her bows more deeply than if she were at rest in calm air and a smooth sea.

Fig. 50.



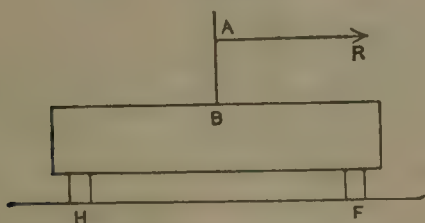
To illustrate this matter let us consult *fig 50*. This figure gives in outline a vessel whose water line when at rest is *F G*. *A B* is a mast and at a point *C* is applied a force *R*. This force denotes the wind force on the sail that is fastened to *A B*. The effect of *R* is not only to urge the ship forward, but to make the point *G* of the ship dip under water. At the same time the part *F* of the ship will rise some distance from the water. After the bows have thus dipped somewhat, and the stern of the ship has lifted, there will be increased upward water pressures round the fore part of the ship, and decreased upward water pressures at the stern. In this way the tendency to dip still further is checked.

Fig. 51.



To illustrate this point by an experiment let us take a small model of a four-wheeled carriage. This model may be made of wood or of paper. Let *F* in *fig 51* denote one fore-wheel and *H* one of the hind wheels. Let an upright mast, stick or pencil be fastened to the carriage. At *A*, the top of the mast, attach a string, and give this string a sudden horizontal jerk in the direction *H F*. Then we shall see the hind wheels flung up from the ground. The carriage will plunge or pitch forward. Actual wheels are not necessary in the model. It is sufficient to construct any body or package of the shape shewn in *fig 52*.

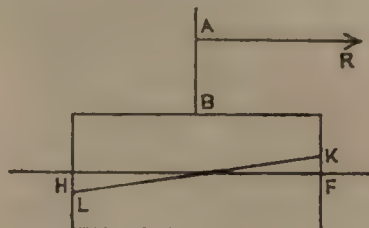
Fig. 52.



If we return to *fig 52* and imagine the model carriage urged forward by a succession of sudden or gradual pulls on the string then the carriage has always a tendency to pitch even although the hind wheels may never actually leave the ground. Let the carriage when at rest give a collective pressure of *P* lbs. on the fore wheels, and of *Q* lbs

on the hind wheels. Then when the carriage moves forward in obedience to the pull of the string, the collective forward pressure will be $P + x$ and the collective hind-wheel pressure will be $Q - x$. The quantity x will vary with the inequality of the pulls or jerks. If at any time x approaches the value *Q* the hind wheels are on the point of leaving the ground.

Fig. 53.



Instead of a carriage or any other body on dry ground we may as in *fig 53* float in water any body provided with a mast *A B*. On jerking the string forward we shall see that the body not only shoots forward, but momentarily dips its front part. Thus the water line changes from *H F* to *L K*.

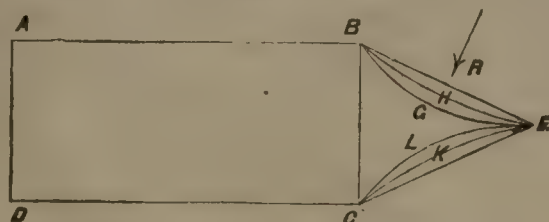
When a ship is propelled by a wind exactly behind it, and the sails are set square this wind is not usually a constant force acting on the sails. It is a characteristic of wind to vary its strength—to come in gusts. Each fresh gust of wind will quicken the ship's motion, and at the same time give her bows a temporary further dip. Even if the wind force was absolutely constant there would be a dip. But this dip would then also be constant. Thus in *fig 53*. If *H F* be the water line of the ship or body when the body is at rest in calm air, this water line would change to some line like *L K* when the ship or body moves forward under a force strictly horizontal and strictly constant in magnitude and direction.

Instead of the body shewn in *fig 53*, it is sufficient to take any rod *A B* and load it at the end *B* with lead or any other heavy material to make it float vertically. Then this upright rod pulled by a string *R* will shew its tendency to dip as well as to move forward.

In each model we may unfasten the string and refasten it lower down. Then we shall find that the pitching, plunging, or dipping tendency is diminished. Finally we may reach a point in the mast or in the body itself where the string may be attached, and the dipping tendency will entirely disappear. Below this point the dipping tendency is reversed. The string is supposed always to be pulled horizontally.

Now we can alter the point of attachment of the string *i.e.* the point of application of the force in our models. But in the real ship *R* is the resultant of the wind force on the sails, and we cannot at our will change its position unless indeed we remove, *i.e.*, furl some of the higher sails.

Fig. 35.



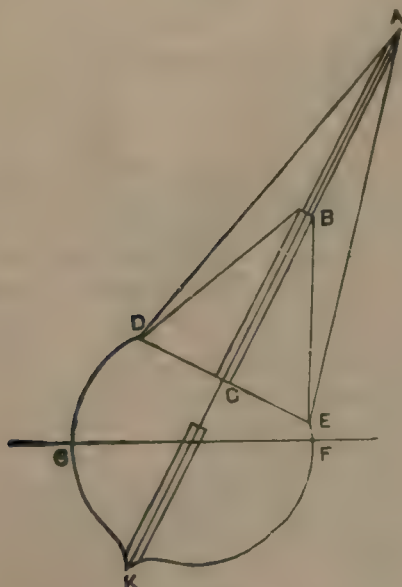
When the ship is moving before a stiff breeze, the sea is not likely to be smooth—waves of water meeting the ship will of themselves cause the ship to pitch. If the bows are made of concave lines meeting in a sharp angle as illustrated in *fig 35* the ship dips under more easily than if the bows were broader. This is one reason—already mentioned—for rejecting the sharp bow with its lines concave to the waves.

When the ship is moving as before, *i.e.*, with the wind

right aft, and the sails set square it may happen that the ship instead of having an even keel has her deck sloping to the horizon. This would happen if a wave striking the ship broadside caused her to roll.

Or it may happen that the cargo is not properly stowed. The volume of cargo on the starboard side may equal that on the left or port or larboard side. But the cargo on the right may be mainly iron while that on the left consists mainly of bales of cotton or chests of tea. In this case the ship will permanently have her deck not level, but sloping downwards to the right.

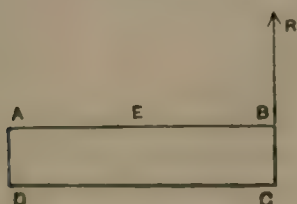
Fig. 54.



Such a case is roughly indicated in fig 54. Here we have an end view of the ship, the plane of the paper being held vertical. If the wind blows northwards we look northwards at the paper. The ship is tilted over towards the right. Thus the sails instead of being symmetrical over the ship have the centre of their area also carried over to the right. It follows that the wind instead of acting vertically over the centre line of the ship acts to the right of this centre line. The resultant R of the wind action on the sails would have its line of action vertically over C, and also vertically over K if the deck D E were horizontal. When the deck has a slope, the force R is neither over K nor over C, but perhaps it is over E or over some point in C E, or in C E produced. The resultant R of the wind force acts at some point in the line C A. The sails on the mast C A are here supposed to be symmetrical with respect to the line C A.

Now the effect of the wind force will no longer be merely to drive the ship due North, and make the bows dip. It will also make the ship alter its course i.e., the direction of its travel. The ship will commence to turn her bows towards the West. This action must be opposed by the rudder, otherwise the ship will cease to travel due North in which direction we suppose her destination to lie.

Fig. 55.



To illustrate this point experimentally let us consider fig 55. A C is a body of any elongated shape either resting on the ground or floating in water. To one end B attach a string, and pull it horizontally at right angles to the length A B of the body. The body will move

forwards in the direction of R the pulling force. But it will also turn round so that if A B were initially due East, it will now become a line to some extent North of East. If we desire that the string may not cause such rotation we must fasten it at some other point E. If we fasten it at A, an opposite rotation is produced. The principle involved in this case is really the same mechanical principle as was illustrated by our models or figures 51, 52, 53.

As another illustration, we may suppose a boat rowed with its oars all on one side. In this case the boat will not travel straight onwards, but will turn round unless the rudder is called into action to resist the turning tendency.

NOTES FROM HOME.

(From our own Correspondent.)

THE Butterley Works, Sheffield, have now in hand a number of bridges designed by Sir Douglas Fox, C.E., for the South Indian Railway of a type which is not often seen in this country, and are the first of their kind which have been constructed at the Butterley Works. They are known as the "pin construction type," a construction almost universal in America for large spans. Seven of these bridges are made to span clear openings of 100 feet, one for a length of 120 feet. The main girders, of which there are two in each span, are of the Murphy-Whipple type.

Lately in the House of Commons a motion was made for the appointment of a Select Committee or a Royal Commission to consider the question of acquiring the Railways of the United Kingdom. It seems, however, to have met with little favor, for it was pointed out that besides adding 1,200 millions to the national debt, the Government could not manage the Railways better than they are managed at present, and that it would prove a grave political danger in the State taking over 367 thousand employes with the certainty that troubles as to wages and strikes would from time to time arise, which could not be settled on their merits, but with reference to political questions and with the help of political bribes.

The Leicester Cremation Society have asked to insert a clause in the Local Government Bill to enable local authorities to provide crematories as well as cemeteries. It is proposed to establish a crematory at Leicester for the Central Midland district, including Nottingham, Derby and Northampton.

I regret to have to chronicle the death of Sir Charles Tilston Bright. This well-known electrician, whose name is prominently associated with the laying of the first Atlantic Cable, was born in 1832. When the Atlantic Telegraph Company was formed, the Engineering Department was placed in the hands of Sir Charles Bright, and when the work was completed, and he was only 26 years of age, he was knighted for his connection with the work, and his previous services in the improvement and extension of telegraphs. From Paris comes the news of the sudden death of M. A. Durand Claye, an able co-operator of M. Alphonse, and one of the most eminent Engineers of the Ponts et Chaussées. He was charged with the important service of the sanitary work of Paris, and had devoted all his professional career, it may almost be said, to the improvement of the sanitary condition of the Seine. To him is owing the utilization of sewage in the peninsula of Gennevilliers. He was universally known and esteemed in the scientific world and his premature death is a great loss to the City of Paris, as well as to the Corps of Ponts et Chaussées.

With reference to making Paris a seaport accessible to large ships, a detailed plan has just been submitted to the French Chamber by the undertakers with a petition for a concession. The plan provides for a canal from Rouen to the capital, mostly by aid of the Seine. It is one and half times as wide as the Suez Canal, and 62 metres in depth, the cost being estimated at about five millions sterling. The contractors ask for no State subsidy, but demand the right of levying a certain rate per ton on all vessels passing through the canal.

Messrs. Priestman have a new petroleum engine which deserves notice. This engine uses only the ordinary petroleum of commerce, and is therefore free from the objections raised against the use of so-called petroleum engines employing highly inflammable spirits such as benzoline, &c. It is very simple in construction, having few working parts. The oil from which the motive power is derived is placed in a closed iron tank, inside the foundation, and air is pumped into

this tank until a pressure is obtained of about 5lbs. per square inch. The oil is then mixed with air until it is formed into a vapour, after which it passes into a closed iron vessel or vaporiser, where it is heated, and from which it is admitted into the cylinder, and ignited by means of an electric spark, which is obtained from a small primary battery capable of doing about 30 hours' work without attention, and which can be renewed at the cost of a few pence. The cost of working this engine, taking oil at the present low price is, it is claimed, a little more than $\frac{1}{2}$ d. per indicated horse power per hour. There is no doubt a special opening for a motor of this kind for electric lighting in country places, where gas is costly or not obtainable; moreover, the supplies of petroleum are so vast and the facilities for its transport are being steadily improved. Messrs. Priestman's engine is now working in different places with excellent results.

The Iron and Steel Institute has just held its Spring Meeting at the Institution of Civil Engineers. No less than nine papers were upon the syllabus of work to be done, six of these were adjourned papers, the remaining three being:—"The melting of wrought-iron or steel scrap mixed with ferro silicon in cupola furnaces" by M. Gautier, Paris; "The behaviour of arsenic in ores and metals during smelting and purification processes," and "A new instrument for measurement of color more especially as applied to the estimation of carbon in steel." The Bessemer gold medal was presented by the donor to Mr. D. Adamson, the President of the Institute. Sir H. Bessemer said he was greatly indebted in his early struggles to Mr. Adamson, who was the first person outside Sheffield, who determined to investigate Sir Henry's invention.

The new dome which has recently been erected at Greenwich Observatory is made entirely of papier-maché. It is 18 feet in diameter, and is designed for the Cooke 6-inch equatorial telescope with a photo-heliograph attached to the same mount. It is so light that it can be rotated without the aid of machinery of any kind, and is said to be as strong as if it were constructed of wood or iron.

General Maitland of the Ordnance Department of the War Office, speaking lately at the Annual Meeting of the Foremen Engineers, said he had just designed a gun of 22 tons on Mr. Longridge's wire principle, which had recently been fired at Shoeburyness, the projectile being 380lbs., and the range 21,000 yards (or 12 miles), and the velocity 360 feet per second.

NOTES FROM MADRAS.

(From our own Correspondent).

WE have been having a *chinna* cyclone and a good deal of rain here lately, an agreeable change in the weather being the consequence. The rain has naturally set my mind working in the direction of water schemes. I cannot help thinking it would be a distinct advantage to mankind if some fellow would invent a way of making it rain or hold up to order. I am too busy to go into the subject myself, so I commend it to the unemployed with the assurance that there is a fortune in it. Perhaps Mr. Ewbank who appears to know all about the properties of fluids will take the matter up. By the way, I have looked in vain through his papers for any account of the properties of the fluid known as whisky. This part of the subject must be thoroughly worked up, or the profession will not be satisfied.

I believe this is the day on which aspiring Engineers are to send in their schemes to Government for the water-supply of the Cantonment of Bangalore. I hope some one will solve the problem satisfactorily, for water is a crying want in that agreeable station. I have read General Fischer's account of his scheme in your issue of the 28th ultimo. I do not know how he came to draw up his scheme. It does not appear to have been in response to the invitation of Government which appeared as an advertisement in your paper, for those schemes were not to have been sent in till to-day: and besides they were only to supply the Military with water, whereas the General's scheme is intended to supply both the Civil and Military stations; and he submitted it to the Municipality, and not to Government. I presume he had a private invitation from the Municipality; though even this seems unlikely, as he says he received no assistance whatever from the Municipal Engineer. However he came to do it, here it is, thanks to you, in all the glory of print.

It appears to me that the General has overlooked one detail, and that is, *the getting of the water*. He says:—"I am not concerned now with the water required for irrigation under this reservoir, which, from its present exceedingly small capacity, and from the records in seasons of drought, renders it evident that the ryots are liable to lose all their crops, though it is a matter of no difficulty in such a basin to secure the interests of the Government and the ryots from all such losses by properly designed hydraulic works."

Ay, there's the rub! "Properly designed hydraulic works." Where are they in the scheme? The only thing that is proposed to be done is to increase the capacity of the tank. But "exceedingly small" as the tank is at present, it appears that in seasons of drought it does not get sufficient water to fill it, to meet the requirements of the ryots. Where then is the water to come from not only to satisfy them, but to yield a surplus of 5 million cubic yards yearly for three consecutive years to supply the station? It appears to me that the ryots and the Government will have to fall back upon the "merciful bounty of Providence." Perhaps they have forgotten to do this in the case of the Ooperhalli reservoir for that work, which is certainly capacious enough—I believe 5½ lakhs were spent on it—has turned out a complete failure. Somehow the water which was expected to come into it didn't come. The General estimates the run-off from the catchment at 25 per cent. of the rainfall upon it. If he will look into the records of the Halsur tank he will find that it does not get so much as *ten* per cent. of the rainfall upon its catchment. The late Captain Romilly, R.E., who went very fully into this subject, says in one of his reports:—"Experience shews that .075 of the annual rainfall may be expected to be the yield of a catchment in the vicinity of Bangalore." Here is the catch at once reduced to less than one-third of the estimated quantity. The fact is the soil about the place is of so loose and sandy a nature, that except in heavy showers it does not part with any of the water which falls upon it.

There is a good deal of tall talk based upon *ifs* and *probabyls* which therefore is not worth criticising. Matters of *fact* have been left undetermined. For instance the General says:—"I believe it is quite safe to assume that the Hebbal reservoir has a catchment basin of at least 10 square miles, without interfering with any other claims."

Now here is a vital question in the subject, one that presents itself at the outset, and one that might easily have been determined by observation, yet it is not determined; and though the assumption is made, no calculation appears to be based upon it. We are simply told further on that "all the records shew that the water-supply of this catchment area, if properly stored, will be abundant for double the existing population of Bangalore."

Let us put this assertion to the proof with the above data.

10 square miles = 30,976,000 square yards, and taking the annual rainfall at 36 inches, rather a high estimate, the fall of water on the catchment would be 30,976,000 cubic yards. But the run-off into the tank would only be .075 of this; that is 2,323,200 cubic yards.

The population of the place is set down at 150,000, and it is proposed to allow them 12½ gallons, that is 2 cubic feet, each daily: the annual consumption would therefore be $150,000 \times 2 \times 365$

27

= 4,055,555 cubic yards.

To this must be added say one million cubic yards for cultivation, and at least two millions for losses by evaporation and leakage, bringing the quantity required up to 7,055,555 cubic yards. The tank, as has been shewn, will yield 2,323,200 cubic yards! And yet we are coolly told that it would be sufficient for double the existing population of Bangalore!!

I am not disposed to give any credit to the scheme on the score that "the Hebbal basin can be supplemented from the Arkavutty River by pumping, if more water is required at any time." Because, that is not an advantage peculiar to the Hebbal basin. Water might be pumped from the Arkavutty River into *any* basin. But where, I ask, is the *rationale* of a scheme which requires as an auxiliary a factor which could yield the required service more efficiently by itself, than in subordination to the principal to which it is an auxiliary? If there is to be a pumping station at the Arkavutty river at all, why not pump the water into Bangalore direct from there? Why divert it into a tank by the way, and

have a second pumping station at the tank? Even supposing that the water of the Arkavutty would only be required occasionally, the water-works on its banks and the main to the Hebbal tank must be maintained permanently, and the original cost of them will be the same however they are used. Being installed and maintained permanently they may as well be used continuously and the expensive and needless half-way tank avoided.

The supplying of Bangalore from the Arkavutty River has already been suggested by a Royal Engineer—Colonel Vibart—but the scheme has not been carried out owing to its costliness; the Arkavutty being 12 miles from Bangalore and some 300 feet lower.

I see a sum of Rs. 60,000 is set down in the estimate for compensation. But according to a Bangalore paper the compensation bill is likely to amount to 6 or 7 lakhs. How I wish I had a little land in the neighbourhood of the Hebbal tank! It is not a bad idea to buy some now; only the Municipality have not taken me into their confidence as to whether they are going to carry out the scheme or not. I might have the land thrown upon my hands. I will conclude this review by offering them one word of advice, and that is not to make any arrangements for pumping the water until they have got it to pump. As the immortal Mrs. Glass says by way of preface to her instructions for cooking a hare—"First catch your hare." Let them not be led away by the notion that Generals of Royal Engineers never let their clients in. They need look no further than the Ooperhalli reservoir for an instance to the contrary. Let them—

Remember, then, that when a boy
I've heard my Grandma tell,
"Be warned in time by others' harm,
And you shall do full well!"

It was very good-natured of you to put in a word for those poor South Indian Railway men whom I had occasion to reflect upon in my last. But good nature is your weak point. I assure you if you knew as much about them as I do, you would agree with me that they are past praying for. You just ask the Consulting Engineer for Railways here to furnish you with a list of all the failures that have occurred on that line during the last ten years; and I am sure you will come to the conclusion that so far from being too hard upon them, I did not give them half what they deserved. Some of the failures have been simply disgraceful. I recall to mind one where a bridge cracked all over as soon as the girders were put on, and had to be taken down and re-built. You should have seen the scathing remark of his Grace the Duke of Buckingham, who was Governor of Madras at the time, upon the failure. The crack Engineer who built the bridge still ornaments their staff. I could tell you a good deal more of their failures and their blunders, but I must reserve it for future communications.

By the way, I have a bone to pick with your Printers. The last time I did myself the honor of addressing you I said we had been having a little *mild* dissipation in the shape of a Fine Arts Exhibition; they have made me say *wild* dissipation. I often congratulate myself that I have nothing to do with printers directly. If I had, I am sure I should soon find myself up at the High Court Sessions charged with culpable homicide not amounting to murder.

BURMA.

(From our own Correspondent.)

On the recommendation of the Director-General of Indian Marine, the local Government is about to introduce Indian coal into Burma; which, if successful, will greatly diminish the English importation. A Bengal coal company is now offering the fuel, deliverable at this Port, for Rs. 15 per ton, which would give a saving of Rs. 10 per ton, when compared with the rate paid for the English article. Trials are now being made in all Government vessels, and if favorably reported on, the State Railways will also follow suit. The only large consumers of English coal will then be the Irrawaddy Flotilla Company, who import their own fuel; but we hope to see at a near future that the resources of Burma will supply all necessary demands, as soon as the Coal-fields near Thayetmyo and Upper Burma are thoroughly exploited. For the present it is proposed to keep a stock of about 3,000 tons, which will be distributed to the principal riverine stations in Upper Burma, for use of the Government launches, &c.; and about a similar quantity will also be stored at Rangoon for the Indian Marine steamers touching at this

port. This step should be the means of giving an impetus to managers of the Indian collieries, who should now make every effort to oust the foreign fuel from the market.

The Irrawaddy Flotilla Company, has now turned its attention to the stability and special fittings of their fleet of vessels, owing to the dangerous tides and strong currents experienced in the voyage up the Upper Chindwin, causing considerable inconvenience to passengers, also shifting of cargo, and thus endangering safety of vessels. Arrangements are now made to stow the cargo properly, by means of efficient shifting boards and securely fastened bulkheads where such are required, on account of the density of the cargo. Many of the river steamers carrying grain, particularly the class of narrow double or treble decked vessels, built some years back, had insufficient stiffness when fully laden to resist heeling to a dangerous angle in the event of cargo shifting, or of water getting below. The effect on such vessels was generally to hold them over at a considerable angle of inclination, not so much as to endanger the vessel. More pumping power is also allowed at the bilges, and the stability of the vessels, when laden with various cargoes is completely determined by calculation before being sent out, and particular instructions given of the empty spaces to be left, or the weight of ballast to be carried for each class of cargo. The steamers of the type now being built have much more beam and built with greater stability, and it is confidently hoped that the attention which is now given to this matter and improvements that have been introduced would lead to a diminution of losses. In connection with this subject we may add that a new salvage steamer, the *Rescue* has been specially built, fitted with all the latest appliances for saving wreckages, &c. She is fitted throughout with electric lights.

The question of building suitable and fast boats for the transport of crude oil from the oil wells at Yanangoung to the Rangoon refinery is now before the Agents of the Rangoon Oil Company who have the entire industry in their hands. The only means of carriage now available are; firstly, by the oil being brought in large open country boats, which, besides being subjected to a loss by evaporation and wastage by leakage, undergoes a greater evil by becoming mixed with water: and secondly, by being filled in expensive empty barrels, for which more freight is charged. To remedy these evils, it has been decided by the Agents to obtain a suitable steam river boat of about 300 tons capacity built on the same lines as those designed for the Russian oil trade and from a plan which we believe was designed by Messrs. Hawthorne, Leslie and Co. We learn that the vessel will be fitted with water ballast in the ordinary way, the crown of the tank forming the bottom of the oil cisterns. The machinery is placed aft, and before this the hold will be divided by two longitudinal bulkheads and by transverse bulkheads into nine separate compartments. We also learn that the steel upper deck forms the crown of the tanks, and the ordinary hatchways formed in the deck serve the purpose of overflow tanks, each hatch being broad enough to serve three tanks. The rivetting of the tanks and cisterns forms an important part in construction, owing to the fact that oil has far greater penetrating power than water, and finds its way through seams that are quite impervious to the latter. It is therefore proposed to space the rivets in both edges and butts closer than is usual in ship work. Special precautions are also taken to build the vessel as far as possible fire-resisting.

The Port Commissioners have under consideration the necessity of lighting the wharves of the port with electric light, and it is believed that arrangements are being made through the Port Engineer to carry out the scheme before the next shipping season. It may be stated that an offer was made by the Flotilla Company to dispose of a complete set of electric appliances, including a 4 H.-P. Engine for lighting a single wharf for Rs. 10,000, and after a series of successful trials that august body declined the offer, for reasons known to themselves.

Considerable progress has been made in the erection of the Rangoon Cathedral, the nave, chancel, cloisters, &c., are fast approaching completion. These sections are estimated at a cost of Rs. 1,40,000, but it is feared that the monsoons, now on, will in a great measure obstruct the work, which was otherwise rapidly pushed on by the enterprising contractors, Messrs. Robinson Bros.

It is praiseworthy to note the interest taken, irrespective of the capital laid out, by private individuals in conducting enterprises taken in hand. Here we have a single gentleman,

Mr. G. E. L. Dawson, introducing the most approved brakes on the line of Railway constructed by him from Thaton to Dvynzeik in the Tennasserim Division, worked by 3 locomotives, 8 passenger carriages and 39 goods vehicles. The brake introduced by him is called the "Automatum" and displays considerable ingenuity of application, and rests its claims on the operations of a well known principle. The normal condition of the brake, when off, is a state of partial vacuum, produced by a steam ejector, which withdraws the air from the pipes and cylinders, thus causing the brakes to gravitate off. To put the brake in, the air is admitted, and the effect is at once produced. The ejector stands in lieu of the steam cylinder and air pump, and the destruction of the vacuum which is never required beyond 12½ lbs per square inch does the work as effectively as 80 lbs. of air pressure. It is well known that the application of a natural law is much more simple and reliable than the employment of mechanical means to produce pressure. Any ordinary driver or railway workman can almost at once grasp the principles of its action. There can be little wonder that this system of brake, so simple in its action, and so readily understood, is growing into universal favor, and we would commend this appliance to railway companies.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, May 26, 1888.

Upper Burma.

With reference to *Burma Gazette* Public Works Department, Lower Burma, Notification, dated the 11th May 1888, Mr. M. Birkbeck, Executive Engineer, 2nd grade, reported his arrival at Mandalay on the afternoon of the 16th May 1888 and is posted to the Mandalay Garrison Division, which he assumed charge of from Mr. B. Baxter, Executive Engineer, 2nd grade, sub. *pro tem.*, on the afternoon of the 18th idem.

Mr. B. Baxter, Executive Engineer, 2nd grade, sub. *pro tem.*, is transferred from the Mandalay Garrison Division to the charge of the Ruby Mines Division.

With reference to *Burma Gazette* Public Works Department, Upper Burma, Notification, dated the 19th May 1888, Mr. H. Hoynes Fox, Executive Engineer, 4th grade, sub. *pro tem.*, will remain temporarily attached to the Ruby Mines Division, on special duty, until further orders.

Lower Burma.

With reference to *Gazette of India* Public Works Department Notification, dated the 2nd May 1888, Mr. V. C. French, Apprentice Engineer, reported his arrival at Rangoon on the forenoon of the 21st instant. His services are placed at the disposal of the Special Superintending Engineer, Upper Burma.

Mysore, May 26, 1888.

Mr. C. A. Mahadeva Shastri, B.A., B.C.E., Assistant Engineer, attached to the Hassan Division, is granted privilege leave for 1 month with effect from the 15th instant, or date of departure.

Punjab, May 31, 1888.

Irrigation Branch.

Rai Bahadur Ram Dial, Executive Engineer, 4th grade, from the Muzaffargarh Division, which he left on the afternoon of the 27th April 1888, to the Upper Sutlej Division, Inundation Canals, which he joined on the afternoon of the 1st May 1888.

Bombay, May 31, 1888.

His Excellency the Right Honorable the Governor in Council is pleased to appoint Honorary Lieutenant and Deputy Assistant Commissary J. O'Sullivan, Sub-Engineer, 1st grade, to be an (Extra) Assistant Engineer, 1st grade, with effect from 1st January 1888.

India, June 2, 1888.

Mr. J. T. Simpson, Executive Engineer, 2nd grade, and Mr. J. A. Price, Executive Engineer, 3rd grade, Bengal, are permanently transferred to Burma Provincial Establishment.

Mr. A. H. Mason, Executive Engineer, 4th grade, temporary rank, and Mr. W. A. E. Hanby, Assistant Engineer, 2nd grade, are permanently transferred from Bengal Provincial Establishment to the Railway Branch of that Government.

The services of Mr. F. St. G. M. Smith, Executive Engineer, 4th grade, temporary rank, Rajputana, are placed temporarily at the disposal of the Government of India, Foreign Department.

Major W. H. Coaker, R.E., Deputy Consulting Engineer for Railways, Madras, is appointed to officiate as Consulting Engineer for Railways, Madras, during the absence on privilege leave of Colonel C. J. Smith, R.E., or until further orders, with the rank of Officiating Superintending Engineer, 3rd class.

With reference to Public Works Department Notification, dated 4th May 1888, Major R. A. Sargeant, R.E., will, while officiat-

ing as Consulting Engineer for Railways, Bombay, hold the temporary rank of Superintending Engineer, 1st class.

Mr. H. J. Richard, Executive Engineer, 1st grade, Burma, is temporarily promoted to Superintending Engineer, 3rd class.

Mr. J. B. Chirnside, Assistant Engineer, 1st grade, State Railways, passed the Departmental Standard Examination on the 30th December 1887.

Rajputana.

Mr. H. E. Grant, Assistant Engineer, 2nd grade, is granted twelve months' furlough from such date as he may avail himself of it.

Military Works Department.

Lieutenant W. Huskisson, R.E., Assistant Engineer, officiating as Executive Engineer, Quetta Division, Military Works, from the 5th February to 1st March 1888, including the interval between the taking over charge of the Division from Captain E. Glenner, R.E., and the making over charge to Major Carwood on that officer's return from privilege leave.

Central Provinces, June 2, 1888.

With reference to Notification, dated 12th current, Mr. G. G. White, Executive Engineer, surrendered, and Mr. M. Leslie, Executive Engineer, received charge, of the Kanhan Division, on the afternoon of the 16th idem.

With reference to Government of India, Public Works Department Notification of 15th current, Mr. A. Scott, Honorary Assistant Engineer, on return from privilege leave, is posted to the Jubbulpore Division.

With reference to Notification, dated 3rd current, Rao Sahib D. S. Sathaye, Assistant Engineer, Jubbulpore Division, availed himself of the privilege leave granted to him on the forenoon of the 20th idem.

Mr. M. Leslie, Executive Engineer, 3rd grade, attached to the Kanhan Division, is granted six weeks' privilege leave, from such date as he may avail himself of it.

With reference to Notification, dated 12th May 1888, Mr. G. G. White, Executive Engineer, reported his departure from Bombay on the furlough granted to him on the 24th current.

Assam, June 2, 1888.

Mr. W. E. Knight, Apprentice Engineer, who was appointed in Government of India Public Works Department Notification, dated the 2nd May 1888, republished in Assam Public Works Department Notification of 11th May 1888, is posted to the Goalpara district. Mr. Knight reported his arrival at Dhubri on the forenoon of the 26th May 1888.

Mr. Knight, Apprentice Engineer, is temporarily transferred from the Goalpara district to the Khasi and Jaintia Hills Division.

Bengal, June 6, 1888.

Establishment—General.

Mr. P. G. Jacobs, Assistant Engineer, is transferred from the Darjeeling to the Kalimpong Division.

Mr. J. A. Devenish, Assistant Engineer, at present on special duty under the orders of the Inspector of Local Works in the Rajshahye Division, is temporarily attached to the Darjeeling Division for special duty.

Mr. W. H. King, Officiating Inspector of Local Works in the Bhagulpore Division, is appointed to officiate as Inspector of Local Works in the Patna Division, in addition to his own duties during the absence of Mr. Joll on deputation, or until further orders.

Mr. E. J. Martin took over charge of the office of the Chief Engineer and Secretary to the Government of Bengal, in the Public Works Department, from Lieutenant-Colonel C. W. I. Harrison, R.E., on the forenoon of this date.

Mr. Martin made over charge of the office of Superintending Engineer, Western Circle, on this day to Mr. H. Joll, Inspector of Works in the Patna Division.

Establishment—Irrigation.

Rai Annada Prosad Sirkar, Sahib, Assistant Engineer, Brahminee-Byturni Division, is allowed privilege leave for three months, from such date as he may avail himself of it.

Mr. J. H. Apjohn (Executive Engineer, 1st grade), Superintending Engineer, Kidderpore Dock Works, is granted special leave out of India for four months and a half, with effect from the 16th June 1888, or any subsequent date on which he may avail himself of the leave.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 28th May, 1888.

143 of '87.—Nähmaschinen Fabrik Vormals Frister and Rossmann Actien Gesellschaft, of Nos. 134 and 135, Skalitzer Strasse, in the City of Berlin, Prussia, Germany, Sewing machine Makers.—For improvements in weighing machines.

175 of '87.—Basil Ronald Landale, of Benares, in the North-Western Provinces of India, Contractor.—For an improved method of working punkahs by manual power.

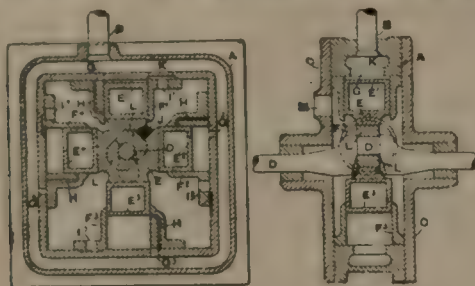
210 of '87.—Frederick Alexander Shillingford, of Kolassy Factory in the District of Purneah and Presidency of Bengal, Indigo Planter.—For improvements in Lever Presses with improved press boxes to suit the same for pressing Indigo *jeuda*.

237 of '87.—Francis William Tytler, Superintendent of Post Offices, residing at Gorakhpur.—For separating and obtaining the indigo (blue or green) from the liquor or water in which the Indigo plant has been steeped, called "Tytler's process for separating Indigo blue or green from the liquor in which the Indigo plant has been steeped."

238 of '87.—Francis William Tytler, Superintendent of Post Offices, residing at Gorakhpur.—For heating liquid by means of an apparatus, called "Tytler's liquid heating apparatus."

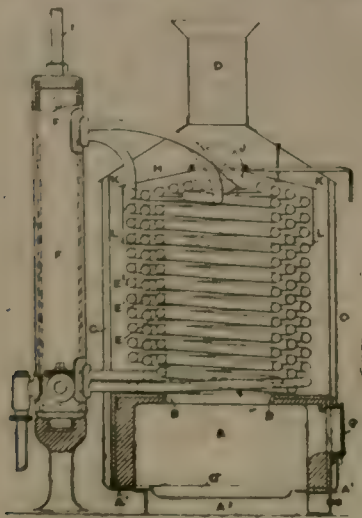
RECENT BRITISH PATENTS.

STEAM ENGINES.—*W. P. Thompson, Liverpool. (G. Smith, New York.)*—The construction of the cylinder and pistons will be understood by reference to the accompanying diagrams. Fig. 1 represents a sectional elevation at right angles to the crank shaft, and Fig. 2 shows a cross section in a plane passing through the shaft. The



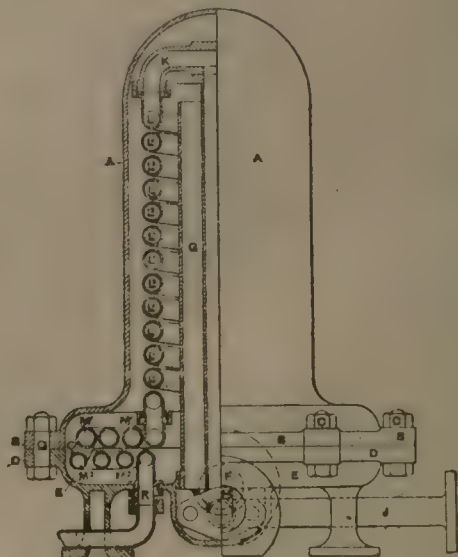
outside square box A contains a channel K within it, through which the steam is conducted to the exhaust pipe B. The crank shaft D and crank pin D¹ have motion given to them by the four-sided piston E, which is boxed to the crank pin by the brass box L. The piston has four projecting parts E¹ E² E³ E⁴, which enter the four cylinders F¹ F² F³ F⁴ respectively. The cylinders bear upon the inner faces of the square box, and in their lateral travel act also as valves. The steam is admitted to the interior of the casing through the aperture M, and the pressure of the steam on the surface of the cylinders holds them upon their seats. In the position of the parts as shown in Fig. 1, the full steam is supposed to be entering at the port I¹. With the further movement of the piston the steam is admitted to the outer faces of the portions E¹ E² in succession, and the exhaust ports G¹ G² G³ G⁴ are also opened in consecutive order. The cylinders are provided with the auxiliary exhaust passages H. Each section of the piston travels back and forward within its cylinder through a distance equal to twice the radius of the crank, and also through a similar lateral distance along the side of the box. Each point of the piston, therefore, traces out a circular path. This shape of engine is designed with a view to simplicity of construction, and also to obviate the usual dead centre. Three claims are made for the shape of the piston, and for the cylinders which act as valves, as described.—No. 4663. 29th March 1887.

STEAM BOILERS.—*J. A. Batley, London.*—In that class of boilers where steam is generated by passing the water through coils which are directly exposed to the heat of the furnace, it is found that the steam supply is too intermittent to afford a constant force for practical purposes. The object of this invention is to remedy this defect, and also to arrange a more efficient indicator of the pressure of the steam and water within the generator. The method pursued by the inventor will be understood by reference to the accompanying figure. The apparatus consists of three separate vessels, the boiler C, the water reservoir F, and a steam reservoir placed behind F, and connected with it by a pipe F¹. The water is forced by a pump into the vessel F, from whence it passes through the coils E E¹ E², and rises through them into the top of the chamber F. The steam, which has been generated during the travel of the water, is led into the steam



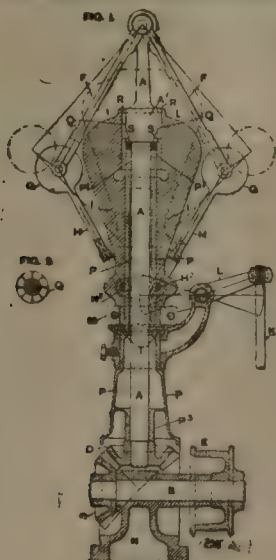
chamber through the pipe F¹, where it forms a constant source of fluid pressure, while the water which has not been altered is allowed to fall to the bottom of F, where water again joins the supply. A gauge is placed in the vessel F, just below the opening F¹, to enable the attendant to ascertain the state of the water and steam within. The cylindrical portion of the casing C consists of two thicknesses of sheet metal, between which a non-conductor is interposed. Of the three coils E E¹ E², the coil E¹ contracts at its upper end to a diameter smaller than that of the innermost coil, and thereby presents an intense heat to the contained steam immediately before its passage out of the boiler. Above the coils a curtain H is situated, being supported by bolts hanging from the coned part of the casing. This curtain is formed of a slightly dished annular plate, with a flange L for the purpose of directing the flames and gases through the outermost coil into the chimney K when the damper J is closed. The furnace A consists of a cylindrical casting, resting on the bed plate A¹, and upon the same plate the fire bars G are carried. The coils are supported on the plate B, and, in order to facilitate their junction with the receiver F and to break up the lateral draught of the gases of combustion, the outermost and innermost are made in the form of a right handed helix, and the other one is laid in the reverse direction. The inventor makes two claims for this apparatus, designed to make the supply of steam constant.—No. 2967. February 25th, 1887.

SEA WATER DISTILLERS.—*G. Gravely, London.*—The improvement in condensers for sea water distillers, included in this invention, enable the condenser to be easily opened for examination. The sea water discharge pipe is connected with the base of the apparatus, the steam pipe is carried through the sea water discharge pipe, and spiral condensing coils are combined with volute refrigerating coils. The construction of the condenser is shown in section and elevation in the annexed figure. The shell A is formed at the bottom with a flange B, which is connected by the bolts C to a corresponding flange on the base E. The sea water pipe F is connected to the base E at one side; by its means the whole of the shell is kept filled with sea water. The sea water discharge pipe G is placed vertically in the centre of the condenser, extending from the base upwards; at its lower end it communicates with an outlet H. The steam pipe J enters the outlet H and passes up



through the centre of the discharge pipe G; when it emerges from the discharge pipe it divides into three branches K, which communicate respectively with the three refrigerating coils L¹ L² L³. The innermost turn of the first refrigerating coil M¹ has three sockets, which respectively receive the lower ends of the three L¹ L² L³. The second volute refrigerating coil M² is connected at Q in its outermost turn with the same turn of M¹. The fresh water discharge pipe R is connected to the innermost turn of the coil M². It will be seen that all the inlets and outlets are at the base of the apparatus, and are below the line of connection of the shell A and the base E; hence, by merely unscrewing the bolts C, the shell can be lifted off without disconnecting any pipes or valves. The inventor makes five claims for the disposition of the various coils as described and shown in the drawing.—No. 5841. 21st April 1887.

GOVERNORS.—*J. H. Street, Workington, and Tangyes, Limited, Birmingham.*—This invention relates to certain improvements in the construction of Porter's governor; the accompanying fig. 1 illustrates such a governor containing the present improvements. A is the vertical spindle driven from the horizontal shaft B by the bevel and mitre wheels C and D; the shaft B receives its rotating motion by means of the band pulley E. The pair of links F are jointed to the upper end of the spindle A; the balls G are jointed to these links, and also to the links H which turn on the pins H². The weight I is suspended by the links H, and rotates with the spindle A. The rising and falling motion of the arms and weights is transmitted to the regulating valve through the rod K and lever L, which is jointed to the collar M. The driving gear C D of the governor is supported on the cast-iron base N, which is surmounted by the hollow pillar P. The spindle works in bearings P² and P³, which consist of portions of the hollow pillar of less diameter than the intermediate parts; the shaft A is thus only in contact with P at these bearings. The part A² is enlarged, and forms a shoulder which works upon and is supported by a series of washers Q. In fig. 2 one of these washers is represented; it will be seen that radial grooves are cut in the faces in order to facilitate lubrication; the friction of the washers is reduced by distribution over a number of working faces. The



simultaneous rotation of the shaft A and the weight I is effected by the cotter R, which passes through the shoulder A², and whose projecting ends engage in the slots S at opposite sides of the weight I. The top of the hollow pillar is preferably higher than the centre of gravity of the weight I and the balls G. By this disposition of the centre of gravity the defect of "wobbling" is obviated to a large extent. The inventors make three claims for the arrangement of the hollow pillar, for supporting the spindle on the pillar, and for the system of anti-friction washers as described.—No. 6013. 25th April 1887.

Advertisements.

DISTRICT BOARD NOTICE.

WANTED a competent Overseer, salary Rs. 70 per month, including travelling allowance. The candidate should possess the certificate of an Overseer, Public Works Department, with two years' practical training. Certificate from his last superior officer is indispensable.

Applications, with copies of testimonials, will be received up to 15th June 1888.

KHETTRO NATH BANERJEE,
Offg. District Engineer,
MYMENSINGH.

MYMENSINGH
DISTRICT ENGINEER'S OFFICE, }
The 2nd June 1888.

NOTICE.

WANTED an Overseer for the District Board, Midnapore, on a salary of Rs. 60 and Travelling Allowance Rs. 25 per mensem. Candidates must be qualified according to the Rules laid down in the *Calcutta Gazette*, part IX., page 79, dated 14th March 1887.

Applications will be received by the undersigned up to the 15th June 1888.

C. VOWELL,
Chairman, District Board.
MIDNAPORE.

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CYLINDER
ENGINE

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SPINDLE
BATCHING
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Stocks of all descriptions always in hand. Contracts at reduced rates.

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DRILLING MACHINE FOR SALE.

LYING at Rajmai Tea Estate, Sibsagar, Assam, a new double gear Drilling Machine, 2½" Steel Spindle complete.

A set of 22 Morse Twist Drills ½ to 1½. A set of 22 Common Twist Steel Drills. Cone for four speeds, also hand action.

Lately imported, and is to be sold, as it is much too large for the Garden's work.

For further particulars apply to—

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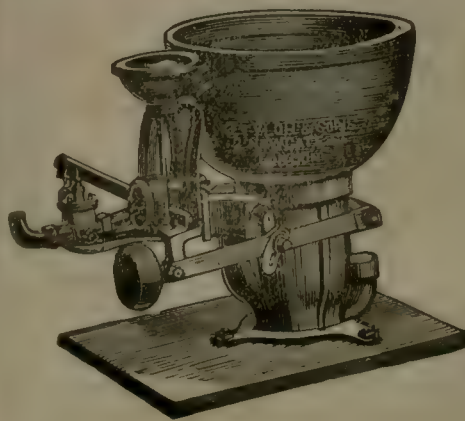
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The Office of Publication of *Indian Engineering* is at the "STAR PRESS," 19, Lall Bazar, Calcutta.

General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

It is particularly requested that all letters on business concerning subscriptions and advertisements be addressed to the "Managing Agents," MESSRS. BALMER, LAWRIE & Co., 103, Olive Street, Calcutta; and all remittances be made payable to them.

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As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

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INDIAN ENGINEERING.

SATURDAY, JUNE 16, 1888.

SIR CHARLES ELLIOTT AS A FINANCIER AND AS A FRIEND.

THE flourish of trumpets with which the appearance of three ponderous volumes of the Finance Committee's Report was heralded apparently left little doubt of the earnestness which marked the Committee's labours and that of their spokesman, Sir Charles Elliott, who is a host by himself. But that he should have stultified himself in the same breath is what we never expected, nor thought it could ever be possible. Facts, however, are stubborn things, and our readers will hardly be prepared for the announcement that while all this fuss is going on about the reduction of Provincial Contracts and other cognate subjects, the President of the Finance Committee has gone out of his way to subsidize a rival Journal at the cost of the rate-payers, by taking in on behalf of the Government 200 copies of that paper from the 1st of July next. That organ was obliged to confess the other day that it has all along been carried on at a dead loss, and as if that was not sufficient, Government or, we should rather say, Sir Charles Elliott must needs sink public money in a dubious enterprise! What could he adduce in defence of such a reckless policy? To say the least of it there is a wide gulf between his practice and his professions. With the fate of the Roorkee "Papers," which died of sheer inanition, staring him in the face, although backed by Government support and Government prestige, he dares to trifle with the purse of rate-payers in the teeth of public opinion. Indian rate-payers should enter a strong protest against this wilful extravagance for which there is not even a shadow of an excuse.

ARBORICULTURE IN THE PUNJAB.

WE are always glad to welcome utilitarian manifestations that war against the pettinesses and hindrances to progress of red-tapeism. In the light of a sensible reform therefore do we incline to regard the substitution of triennial Forest Department Reports on Arboriculture in the Punjab for the yearly ones formerly held necessary. The new departure must be a very sensible relief to hard-worked, not too-well-paid and pensioned forest officers. That is no small advantage. But an advantage more likely to come home to the general public is that, obviously progress made in tree planting can be better judged when the operations and results of three years work are massed together for its purview than they can be from often contradictory seeming reports on annual doings and undoings.

The Punjab Secretariat, true to Secretariat interests, appears to think that it has done its duty to the Forest Department in the issue of a new Manual of Instruction. As if officers of the Department were not already too much burdened with forms and formalities! However, these are incidental to departmental work, and must needs be borne with as good grace as a man of sense may be

able to command. Regretting their incidence, and the unnecessary bother they must needs give to already over-worked officers, let us proceed to consideration of the Report before us. It deals with very satisfactory practical results, in spite of the time more or less wasted in minute-writing for Secretariat waste-paper baskets.

Paragraph IV. shall speak for itself:—The net result of tree-growing operations on avenues during the triennial period 1884-87 has been an increase of 7,093,302 feet, or 1,343 miles in the length of district roads planted. The Lieutenant-Governor agrees with the suggestion of the Arboriculture Committee that lengths should be reported in miles and furlongs and not in feet, and entries in future years should be calculated accordingly. Since the 1st of April 1884 the area allotted to groves has increased by 4,925 acres, from 2,143 acres to 7,068 acres; but of this area 2,735 acres still remain to be fully stocked. Since the same date the area on which nurseries are maintained has increased from 101 acres to 324 acres. An area of 1,208 acres, constituting the Tilauri plantation in the Delhi District, is excluded from this account. It is remarked by the Conservator that there are now only three districts in the Punjab which do not record an area of greater or less extent under nurseries. These districts are Umballa, Montgomery and Kohat; but from the detailed report of the latter district it would appear that two small nurseries have been established in it, and that young plants are supplied for roads from the Municipal garden. In 1884 nurseries existed in ten districts only.

Forest operations on canal avenues and groves are progressing satisfactorily, we are told. But the accounts have got muddled: the figures have at least; they always do in the Secretariat; and so opportunity for comparison of current year totals with those that have gone before is "rendered difficult." And so, as usual, enquiry is shirked. We are told, however, that the increase in the length of provincial roads planted with trees during the triennium of which some account is given in the State Paper before us amounted to 123 miles. We would fain hope that a good portion of this mileage is represented by shade-affording and fruit-bearing trees; and we hope, moreover, that it has not been devoured and nibbled out of all utility by goats. One would like to know what the Indian goat was created for—"Jumna Paharis excepted." They give no milk; they do no work, unless it be assistance of a blind beggar in his mendicancy; they are not fit to eat, even at a dāk bungalow; they never spare a growing tree, and are viciously cunning in their assaults on its budding and blossoming—Anathema Maranatha! When Dr. Vincent Richards has got tired of experimenting on himself with Cobra poison let them be made over to him. *Fiat experimentum in corpore vili?* the old world axiom says.

But this is a digression. We are glad to hear that good work is being done in the Gurgaon districts, under the superintendence of Mr. Maconochie. Work in connection with the afforestation of hill wastes.

In the orders of Government on the Report of the Arboricultural Committee, it was stated that Mr. Lyall

agreed with the Committee that it is to the Commissioners of Divisions that the chief administrative authority in the supervision and encouragement of arboriculture must be entrusted. His Honor hopes that these orders will be borne in mind on future occasions.

THE P. W. D. AND THE FINANCE COMMITTEE'S REPORT.

THAT the labours of the Finance Committee have not resulted in the traditional birth of a mouse, is quite apparent from the three massive volumes issued by the Government of India embodying the researches of the Committee on all points referred to them for consideration. Two volumes are devoted to the report of the Committee proper and the third is appropriated by the Financial Commissioner for his special remarks and to complete the work abruptly left unfinished by the orders of the Government of India. Before entering into a discussion of the papers relating to the particular subject under notice, we will take a bird's-eye view of the conclusions the Committee has arrived at in the matter of general retrenchments. The savings recommended amount in all to Rs. 1,23,47,000 of which 69 lakhs is the outcome of the saving likely to be effected in the Provincial contracts. A comparison of the economies suggested in the several Provinces may not be uninteresting. In the Punjab the revenue and expenditure have been so well adjusted that the renewal of the contract will bring no benefit to the Imperial Government. For obvious reasons Burma will, for some time in the future, be a veritable "White Elephant" on the hands of the Government, and it will admit only of a provisional renewal of the contract. It is calculated that the North Western Provinces could conveniently add to the coffers of the Indian exchequer, Rs. 12,65,000; the Central Provinces Rs. 1,85,000; Bombay, Rs. 27,06,000; Madras Rs. 14,07,000; Bengal Rs. 11,52,000; Assam Rs. 1,86,000. These amounts, as we have said above make a total of Rs. 69,01,000 by the renewal of the Provincial contracts as suggested by the Committee. Then again the latter have recommended certain retrenchments in provincial expenditure which have not as yet come under the direct consideration of the Government of India, but which, if acted upon, will result in the following savings:—Punjab, Rs. 1,88,000; North Western Provinces, Rs. 1,73,000; Central Provinces, Rs. 24,600; Bombay, Rs. 3,80,000; Madras, Rs. 4,02,000; Bengal Rs. 3,64,000; Assam, Rs. 17,600; Burma, Rs. 22,000, giving a total of Rs. 15,71,200. Next come the retrenchments recommended by the Committee in the Imperial and Miscellaneous Departments which are represented by a sum of Rs. 43,75,000. It must, however, not be supposed that all these suggestions have been adopted without reserve; some have been accepted, but the majority are still under consideration and their fate depends upon the view in which the Supreme Government will regard them, whether they are conducive to the proper working of the administrative machinery or not.

In regard to the large and difficult subject of the strength and cost of the entire establishment of the

Public Works Department, the conclusion arrived at by the Committee is that recent changes involving enhanced pay, which were given as a sop to the Cerberus of the discontented party, only as a temporary expedient, should not be continued in the case of future appointments. Now, we would observe in passing, that this is a most mischievous policy and ought not to have had a place in the deliberations of such a body as the Finance Commission, whose duty it was to avoid all means that would give rise to friction in the despatch of business. Instead of admitting that the increase of pay was fairly won by an officer's hard work and he was entitled to it for meritorious services, the Committee take shelter behind the pretence that it was only to prevent discontent the enhancement was made. This would be a tempting morsel to those who not having a genuine grievance will manufacture one for the purpose of trying the mettle of Government, and trust to chance for success. It will result in a thorough demoralization of the service which is already groaning under a heavy load of injustice and disabilities. But this is not all: in view of a large contraction of expenditure there must be a considerable reduction of the establishment which, read by the light of recent events, points to the conclusion that those who have no friends in high places will be among those selected to go to the wall. As a corollary to this "the list of charges should be revised so as to lay down what is the number of officers requisite for the work of the Department, and to arrange the recruitment accordingly restricting it in the first place to Royal Engineers and to statutory natives on two-thirds pay, and not indenting on Cooper's Hill College unless it is found necessary to do so." The meaning of all this is plain enough, notwithstanding the cloud of words under which it is hid. The Royal Engineers having been in the enjoyment of the loaves and fishes of the various branches of the Department are to supply recruits direct to the civil branch of the Public Works Department. But to hedge in the claims of its protégés more completely, statutory natives are brought in to the exclusion of Cooper's Hill men, as a blind and to produce a dramatic effect. The "statutory natives," whatever the term might mean, are conciliated at the expense of Cooper's Hill men; they will clutch at the opportunity of entering the service so cheaply, but when once they find that the R. Es get the choice appointments and they are reduced to mere understrappers and subordinates they will not have great occasion to congratulate themselves on the choice of the two evils. With men appointed direct from England, natives have some chance of competition, but with R. Es in the race they will be fearfully handicapped and the odds against them of attaining to the highest rung of the official ladder will be very great indeed. Of course if it is left to the Financial Commissioner he would have none of Cooper's Hill men, but will the latter tamely submit to such an outrageous decision. For years past Cooper's Hill College has been supported by India, in return for which it has supplied her with some of the best Engineers in the

world, and the result is that with a single stroke of the Committee's pen a most deserving class of men are to be carefully excluded from a field of labour in which they have given the most satisfactory work, only to make room for those who are not only strangers to it but have not a tittle of claim to admission in the Department, much less to have the entire control of it. We hope to refer to the subject of "combined establishment" and other cognate matters in our next issue.

LOCAL INDUSTRIES.

A CIRCULAR letter, which has been issued by the well known firm of Messrs. Burn & Co., of Calcutta, calls the attention of the public to the fact that articles mentioned in their catalogue are for the most part manufactured in India, and that the Government of India have laid down special orders, which are quoted in the letter under notice, as to the purchase of goods locally manufactured, and also as to the encouragement generally of local industries. Whatever may be said from the manufacturer's point of view, or from the consumer's, Messrs. Burn & Co. are no doubt right in laying stress upon the declared policy of the Government towards all local enterprise, especially when such enterprise is based upon indigenous material and labor, or even upon labor trained in the country to work imported material, and Messrs. Burn & Co.'s Raneeunge Potteries certainly come under these definitions.

Without entering upon the history of Messrs. Burn & Co.'s various works, it may be noted that the Raneeunge Potteries were established several years ago for the manufacture of stoneware pipes and fireclay goods, (of which they hold, it is understood, a sort of monopoly in these parts,) with very creditable results. The scope of these works has been gradually extended into the more refined and artistic varieties of the potter's art until of late terra-cotta work of very fair quality, and at rates, if anything, lower than English rates have made their appearance, the architect of the Rangoon Cathedral being the first to place an order in their hands for ornamental mouldings, &c. Subsequently the ornamental freizes, &c., for the new Mathematical Instrument Office in Park Street were made there, and it is understood that they have received further orders.

In what are known as brick districts—i.e., like Lower Bengal, where bricks form the chief building material—the use of terra-cotta ought to be encouraged to the very greatest extent; it is well known that the finest effects in "brick architecture" have been obtained by the judicious use of the sister material, terra-cotta, for ornamental purposes; and if the reprehensible practice of using plaster for all ornamental details is to be prevented, it can only be done by finding a substitute in cheaper natural stone—good artificial stone—or in terra-cotta. Of these terra-cotta has great advantages—not only on account of its durability and the ease with which moulded work can be produced, but on account also of the tones of color which can be obtained. It can safely be said that there is a promising future for this class of manufacture.

Notes and Comments.

THE MAISUR GOLD FIELD.—During May, the total yield of the Madras gold fields was 3,246 oz., worth nearly £13,000.

A DEEP BORING.—Mr. Charles Earpe "has beaten the record"! He has already attained a depth of 550 feet at Alipore, which is the deepest coal boring ever effected in India.

A SCANDAL!—From among the several applicants for the post of Head Draughtsman, Mysore D. P. W., on Rs. 100 a month, the Chief Engineer has selected one Mr. Rangaswamy Moodliar, a Pensioned Assistant Engineer of the Madras D. P. W.

SIR GUILFORD MOLESWORTH, K.C.L.E.—A Bombay paper declares that the merits of another exceptionally creditable professional career have been recognized in the inclusion amongst the new Knights, of Mr. Molesworth, Consulting Engineer for Railways to the Government of India.

DIVISIONAL CHANGES, P. W. D., BENGAL.—The Lieutenant-Governor is pleased to direct that the Jessore Public Works Division shall be abolished, with effect from the 1st July 1888. From that date all public buildings in the Jessore and Khulna districts will be in the charge of the Executive Engineer, Dacca Division.

PROPOSED NEW CENTRAL ROAD, CALCUTTA.—Mr. Cotton, C.S., writes:—The Government of India has now refused its assent to the proposal. It is argued that the surplus has been paid for from the general revenues of the East Indian Railway, and that, therefore, the proposed diversion of the funds is opposed to the intention of the Howrah Bridge Act.

INDIAN RAILWAY ADMINISTRATION.—The Secretary of State has sanctioned the amalgamation of the office of Director-General of Railways with the Public Works Secretariat, conditional on further reductions being effected when the North-Western Railway is transferred to the control of the Punjab Government. This transfer is under consideration.

THE UNCOVENANTED SERVICES.—It is stated that the Government of India telegraphed to the Secretary of State that it had no objection to the appointment of a Select Committee to inquire into the grievances of the Uncovenanted Civil Service. The home authorities had, however, apparently resolutely decided to do nothing, and even Lord Dufferin's representation failed to shake its determination.

MILL INDUSTRY IN BOMBAY.—There are new mills to be started in Bombay. But some old concerns are not paying—at least they do not pay any dividends. There are some that guarantee for a period annual dividends at a certain rate. A few of these keep the promise, and others do not. Another great defect in the management of these concerns is that Agents and Directors get for themselves a lion's share of the profit.

LUCKNOW-SITAPUR STATE RAILWAY.—It is reported that the Government of the N.-W. P. and Oudh have for the present relinquished the idea of carrying the construction of the Lucknow-Sitapur State Railway farther. The maintenance of the present length of line, 105 miles, will be added to the charge of the Executive Engineer, Provincial Division, and the services of the Executive Engineer now in charge of the line will be available for transfer.

OBITUARY.—The death is reported from fever, on the 5th instant, of Mr. Phillip Hudson, Divisional Engineer, H. H. the Nizam's Public Works Department, Honamkonda, Deccan. Mr. Hudson was a self made man. He rose from an obscure position in the Madras Irrigation and Canal Company to one of the highest positions in the Nizam's Engineering Establishment. He has a son in the Bombay Civil Service and many friends in the Madras Presidency.

THE P. W. D. SECRETARY TO THE RESIDENT, HYDERABAD-DECCAN.—Mr. H. F. Story has been appointed to succeed Mr. H. F. White as Superintending Engineer and Secretary to Resident, Public Works Department, Hyderabad, pending the return of Mr. J. G. Glass from leave. Mr. Story is a Superintending Engineer, 2nd class, and belongs to the Railway Branch. He comes immediately from Assam where he was in charge of the Chittagong-Chandpore-Kumilla Railway.

A DESIDERATUM.—Vellore wants both drainage and good water; the latter is of the first importance, lying, as the town does, in a valley which forms a sort of funnel through which cholera passes from north to south and back again. Vellore is situated as regards the Palar exactly as Madura is situated as regards the Vaigai. A first-class supply at a comparatively cheap rate is easily available. As Vellore is a military cantonment, it may be hoped that Government will not only favor the proposal, but also contribute towards its execution.

THE PUBLIC WORKS DEPARTMENT IN INDIA.—In the House of Commons, on 14th May, Mr. Mallock asked the Under-Secretary of State for India what number of officers belonging to the Public Works Department in India were now in the employment of private companies or private persons in whose undertakings the Indian Government had no pecuniary interest. Sir J. Gorst replied that the number was 28. Of these 22 were employed in Native States, mostly in connection with Railways, and six were lent to the Government of Egypt.

UMBALLA-KALKA RAILWAY.—For all practical purposes the competitors for the construction of a Railway between Umballa and Kalka are reduced to one. The scheme with which the names of Mr. W. Duff Bruce, Mr. Robert Steel and Messrs. Yule & Co., all of Calcutta, are connected alone survives, and that is by no means unlikely to come off. Mr. Noble's bolder scheme for a line from Umballa to Simla, on a two foot gauge, has not, as was predicted would be the case, found favour with the Government of India.

PROGRESS ON THE BENGAL-NAGPORE RAILWAY.—Considering that the Government sanction to the Asansol project was not obtained by the Company until the 16th of January 1888, progress has been satisfactory on this portion of the line, and we are impressed with the energy with which the preliminaries have been conducted. At the Nagpore end where the work consisted of only converting a narrow gauge Railway, the progress has necessarily been more rapid and it is expected that a few months will see the line opened for traffic from Nagpore to Raighur.

THE UNCOVENANTED SERVICES.—The debate upon Mr. King's motion for improved leave and retirement rules for the Indian Uncovenanted Civil Service, and for the payment of their pensions in sterling was a long and animated one. Sir John Gorst pleaded legal rights against consenting to the proposals urged on behalf of the service. Mr. Goschen said, the question was mainly

whether these pensions should be paid in sterling or in Indian currency. If in sterling, many other cases would require similar relief. The motion was eventually defeated by a majority of 111.

THE MYSORE P. W. D. BUDGET.—The Mysore Government have made an allotment of Rs. 28,74,000 for the Public Works of the Province for 1888-89, being Rs. 4,15,000 more than that of the last official year. The abstract of expenditure heads, is as follows:—Original work Rs. 16,78,800; repairs, Rs. 6,77,900. The largest provision is made for Irrigation Works, on which Rs. 9,65,000 are to be spent, which provides also for roads and for two bridges across the Tungabudra at Balehonnur. Both will be of great benefit to the planting districts of Kodar and Shimoga.

THE HOTTEST PARTS OF INDIA.—On the 10th ultimo, North Sind and West Rajputana were the hottest parts of the Indian region, the maxima of temperature generally exceeding 110° . On the 12th idem the maxima at Jhansi and Deesa were $112^{\circ}5$. On the 13th the highest maxima reported were 114° at Deesa, and $113^{\circ}5$ at Jhansi. On the 14th the temperature had again risen, the highest maximum was $114^{\circ}7$ at Jacobabad. On the 15th the maximum at Jacobabad was $116^{\circ}6$ at Hyderabad (Deccan) it was $113^{\circ}2$. On the 16th a maximum of $116^{\circ}6$ was reported from Jacobabad, of $115^{\circ}9$ at Sirsa, of $115^{\circ}4$ at Deesa, and $114^{\circ}8$ at Ludhiana.

ARCHAEOLOGICAL SURVEY OF INDIA.—The administration of this important branch is, we find, entrusted to persons who have not the slightest pretensions to the science and practice of Architecture, and in the absence of this technical knowledge much that could be treated professionally or in a masterly manner, will be lost to the interested public here and elsewhere and the lovers of Comparative Architectural Archaeology. No one was better suited to hold the reins of this Department than the late Director General, Sir Alexander Cunningham, B. E., whose varied qualifications and vast erudition in the ancient monuments of the country might well entitle him to the honor of being the father of Indian Archaeology.

PATENT STATUTES AND REGULATIONS OF NEW SOUTH WALES.—We have been favored by a friend with a copy of the above, which compares favorably with enactments of like nature in the Colonies and here in India. The law and the regulations thereunder, unlike those of the Medes and Persian, with recent modifications, are sufficiently fair and easy to prove an incentive to inventors. We notice in this connection that Mr. Manfield Newton, C.E., M.E., 115, York Street, Sydney, who has opened an office for the Registration of Patents, Trade Marks and Designs, and whose experience in the profession extends over 16 years, undertakes the execution of Patents, &c, on strictly moderate charges, and will furnish all answers to all enquiries on this head.

SUPERINTENDING ENGINEERS IN BURMA.—The Burma P. W. Department is now divided into three Circles of Superintendence under one Chief Engineer, Colonel W. G. Cumming, R. E., who has earned the appointment bestowed on him. Mr. H. F. White is Superintending Engineer of the First Circle with head-quarters at Rangoon. Mr. A. B. Gatherer has the Second Circle with head-quarters at Thayetmyo, and Mr. H. J. Richard officiates as Superintending Engineer of the Third Circle with head-quarters at Mandalay until Mr. R. Ring, his senior, returns from leave. It is satisfactory to note that all these appointments have been given to officers who

have served in Burma, and not to strangers to the country and its requirements.

THE IRRAWADDY.—Sir Charles Bernard, discussing the natural facilities for commerce of this river, says that "the Irrawaddy, with a course of probably 1,100 miles, is navigable by big river steamers from Rangoon to Bhamo, a distance of nearly 700 miles;" while "some hundreds of miles of cross channels and deltaic mouths are similarly navigable;" that "the steamers which ply to Mandalay with their flats, carry 1,000 tons of cargo and several hundred passengers each trip;" that "the Chindwin, which has a course of about 500 miles, is navigable for 150 miles all the year round and for 300 miles during the rainy season;" that "the Myitnge and the Sheveli are also navigable during the flood season," and that "all these streams and many more are in the flood season navigated by multitudes of native craft, some of which are large enough to carry 120 tons of cargo."

HARD TO PLEASE.—The President of the Kurnool District Board, having represented to the Board that he was dissatisfied with the quantity and quality of the work at present being turned out by the Engineering establishment, the Board assembled, unanimously agreed with him. It was then taken into deliberation how this state of things could best be ameliorated. A proposition to do away with the Engineer and to sub-divide the district under two supervisors was, after some discussion, abandoned, and it was determined instead to try the effect of strengthening the hands of the Engineer by substituting for the present low-paid and thoroughly inefficient overseers a superior class of men on higher salaries. If we recollect aright, it is not long since a glowing tribute was paid to the Kurnool L. F. Engineer when the question of an increase to his salary arose, and it is difficult to reconcile the present proceeding with that past.

WAGES AND WORKING-HOURS IN INDIAN COTTON FACTORIES.—Wide as is the difference in the daily rate of wages, the cost of labour in England and in India affords a remarkable illustration of the practical working of the great law of compensation, by which the cost of labour is more or less equalised all over the world. The investigations of the Committee appointed by the Government of Bombay have shown that a mill in India employs about three times the number of hands and pays approximately the same amount of wages, as a similar mill in England, yielding the same output and producing the same quality of work. The superiority, in point of efficiency, of English labour, is most conspicuous in the case of young hands. An experienced witness, an English manager, examined by the Commission, stated that, while in Bombay a boy attends from 120 to 140 spindles, in England a girl of eighteen, who had been employed by the witness, had attended 512 spindles.

A STEP IN THE RIGHT DIRECTION.—It is gratifying to notice that Sir Auckland Colvin, in the North-West Provinces, is following the excellent example set by the Governor of the Madras Presidency in the matter of urban and rural sanitation, and, as a first step, it is understood that an Engineer will be appointed to the charge of the Sanitary works of these Provinces where advice will be available for any Municipality having works to carry out. This is so far all right, but as no Municipality can engage the services of such an Engineer, or undertake drainage and water works or other improvements without funds, that want should be first supplied. But as this again

cannot be effected without legislation empowering Municipal or Provincial Boards to borrow on their own account for works of improvement, and provide for the payment of interest on, and repayment of, the loan raised independently of Government interference or assistance, some such law is necessary and should, we think, be enacted to apply to all Municipal and Provincial Boards in India.

CANALS AND INLAND NAVIGATION.—It was the intention of the Society of Arts to hold a conference this month on the subject of canals and inland navigation. In the year 1885 an international conference on this subject was held at Brussels, and in the following year there was one at Vienna. The third meeting is to be this year at Frankfurt. It is not, however, proposed that the Society of Arts conference should be of an international character, as naturally the canals of this country are not in any way dependent on, or connected with, those of other countries. Among the subjects set down for discussion are included the history of canals in Great Britain, the engineering of canals, the present condition of canal navigation with suggestions for its improvement, the connection between canals and railways, tariffs, costs of carriage, &c. It is also proposed to include in the proceedings some account of the canal systems of foreign countries, and the committee have already been promised several papers on this head. Further information as to the details of the arrangements may be obtained from the Secretary of the Society of Arts.

P. W. D. ESTABLISHMENT CHARGES, N.-W. P.—The total expenditure on salaries to "Provincial and Local" in the limited Provinces comes to Rs. 12,88,000. We are told that this is distributed as follows: "Imperial works," Rs. 33,300; "Provincial," Rs. 7,00,000; "Local incorporated," Rs. 5,45,500, and "Rurki workshops," Rs. 9,516. This sum of nearly 13 lakhs seems to be made up as follows: The Chief Engineer, his Personal Assistant and their office and travelling expenses absorb Rs. 98,000; 3 Superintending Engineers similarly cost Rs. 79,400; 20 Executive Engineers and 84 Assistants account for Rs. 3,26,436; 65 Upper Subordinates cost Rs. 1,29,600; 95 Sub-Overseers Rs. 45,156; Storekeepers, Native Doctors and menial establishment, Rs. 21,894; Office, Rs. 40,836; District Engineers' offices, Rs. 76,212; with Rs. 1,94,966 for travelling allowances and contingencies. "Construction" absorbs in all Rs. 8,60,100. "Accounts" again cost Rs. 99,000, and the Thomason College 1½ lakh with Rs. 1,900 for "Ganges navigation establishment." We arrive thus at a total of Rs. 12,88,000, of which all but a fraction, as detailed above, is devoted to "Provincial" and "Local" establishments.

THE SONE CANALS.—The report of the Behar Irrigation Commission is, we believe, an elaborate one, containing no less than 37 distinct suggestions for the improvement of the present system of administration. The most important of them is the reform of the entire system on the following lines—(1) the determination of the irrigable areas; (2) the adequate and certain supply of water to such areas; (3) the exclusion of all other areas from assessment, and (4) the co-operation of the landlords and communal representatives, in the distribution of the water and payment of the rate. We believe that the evils the Commission was sent to remedy were proved beyond dispute, but the real difficulty is to suggest an effective remedy for them. The report does not shrink, we hear, from doing this, but we also hear that Mr. Odling, the professional member of the Commis-

sion, and Rai Jai Prakash Lal Bahadur, who represented the people affected by the canals, have both recorded separate minutes differing in opposite directions from the report itself. We believe, however, that their dissents are on minor points, but whether this is so or not, or what the differences are, we cannot say until the report is circulated.

PUNJAB PETROLEUM.—The Secretary of State has confirmed and sanctioned the agreement, already announced by us, made by the Government of India with Mr. J. D. Noble, representing the Syndicate of Canadian capitalists, in the matter of the Rawal Pindi petroleum deposits. Under this agreement, as we have said before, exclusive right is granted to Mr. Noble for three years to bore for oil in the Punjab. If successful in finding it, he will be granted the option of selecting five square blocks of land at different points, containing ten thousand acres each. The surface of the area is not to be interfered with, save where wells have to be sunk. The Government incur no expense, but receive 5 per cent. of all crude earth oil obtained, this serving as a sort of land revenue. The concession will be worked by a limited company already formed, bearing the name of the Punjab and Oriental Oil Company, with a capital of 2½ lakhs in Rs. 100 shares. One of the principal features of the agreement is that the original holders of stock cannot assign or sell their shares to outsiders without the consent of Government. This will ensure the enterprise being kept in the hands of the practical men who have now started it.

STATE RAILWAY ADMINISTRATION.—Dr. Pollen, of Karachi repute, in a recent lecture on the above subject arrived at the general conclusion that the State could not manage Railways as successfully as Private Companies. State management failed to make the Railways pay as they ought to pay. There was frequently reckless expenditure followed by miserable economies and inconsiderate retrenchments—all the odium of mistakes falling on the State. The public grumbled or growled, but were afraid to take action against the State; whereas they would have no hesitation whatever in proceeding against a Private Railway Company. "Am instructed to meet you in Civil Courts" is the State Railway's stereotyped reply to claims for compensation for damage, etc.; whereas a private Company would say "I have the honor to regret the accident, and enclose a cheque for the amount of compensation claimed." He says: Let the State *build* Railways always, but let Private Companies manage them. The State knew best how to deal with Revenue authorities, how to get lands cheap, and how to import Railway materials without paying port, municipal, or other dues. But a Railway once built should be handed over to private enterprise for detailed management.

TRADE LIBERALISM VERSUS TRADE CONSERVATISM.—India with her bankrupt Exchequer and declining rupee, not long since bounteously removed her cotton duties to benefit her Lancashire brethren, but now that India asks for a repeal of the duties on her manufactured silver,—handicapped out of existence by these impositions which amount to 40 per cent. of the actual value of the silver used in the manufacture of the article—with a view to benefit her silver ware, and improve the intrinsic value of the dwindling rupee, she is told by "My Lords of the Treasury that they cannot hold out hopes that the state of finance will enable the Chancellor of the Exchequer to take these (duties) into consideration." We are too

often reminded by the sympathising Britain that India is poor her monetary and material condition need improvement and yet what do we find, her professions are not practices. To please a handful of silversmiths whose conservative selfishness has deadened their feelings towards their brethren here, England positively refuses to hear India's representations on a matter which, while conducing in a small measure to her own welfare, would serve as an impetus to Indian Silver Art manufacture which deserves to be encouraged rather than crushed out of existence.

BENGAL AND N.-W. RAILWAY.—The report of the Directors of the Bengal and North-Western Railway for the half year ending December last, states that the working expenses amounted to Rs. 5,34,867, being 65·32 per cent. of the gross earnings, against 64·54 per cent. in the corresponding half of 1886. The difference in percentage is due to the decreased earnings, for there is an actual reduction of Rs. 12,333 as compared with the second half of 1886, although 73 more miles of line were worked. The net earnings are Rs. 2,83,978-9-5, which realised £20,115 3s. The amount available for dividend is £20,459 7s. 4d. This is sufficient to pay a dividend of £1 per cent. for the half year, free of Indian and English income tax, leaving £114 13s. 10d. to carry forward. Although, in common with most other Indian Railways, this Company has during the past year suffered from an adverse condition of trade, the Board feel confident in the future of the line. The districts served by this railway are densely populated, and it is now established beyond doubt that they produce a large surplus of commodities for which there is a demand, not only for export beyond sea, but also for consumption in other parts of India. There is, therefore, every reason to expect a considerable expansion of the traffic as soon as trade resumes its normal course.

THE NEW PREMISES FOR THE HONG-KONG AND SHANGHAI BANK AT YOKOHAMA.—To Water Street, the Bank has a frontage of 108 feet, with a depth of 74 feet, and a wide verandah with five porticos runs the whole length of the front. Externally the building is of stone. The style is Italian in its general features with Ionic pilasters, but the details shew considerable departure from the stereotyped form, the mouldings being bolder and fewer in number than usual; a departure adopted, we are informed, on account of the dark color of the stone absorbing so much light. The roof has a clear width of 70 feet, without any internal support from below except such as is afforded by the inner wall of the verandah. Internally the arrangements appear admirably planned for the convenience of both the staff and the public, whilst the rooms are large, lofty, well lighted, and handsomely fitted and finished. The Manager's Office is a fine room 25 by 20 feet; the general office a spacious hall 60 by 40 feet, the Cash office 41 by 37 feet, the ceilings being 20 feet high. There are large and commodious strong rooms for treasure and books, together with the necessary offices and quarter for the Chinese staff, and the general working of the office. The lavatory and sanitary fittings are of the newest and best description, from Jennings of London; the whole arrangements reflecting credit on all concerned. The design of the front is due to Mr. J. Conder, of Tokyo, slightly modified by Mr. J. Diack; the remainder, including the arrangement of the interior, the construction and the whole of the details being from the pencil of the latter gentleman, under whose able supervision the work has been executed.

Current News.

MR. HEDERSTEDT, Chief Engineer, goes on three months' leave and Mr. McAdam reigns in his stead.

CAPTAIN C. C. TOWNSEND, R.A., Officiates as Superintendent of the Gun Carriage Factory, Madras.

THE Government of Ceylon has sanctioned the opening of a Forest School at Kandy, and we wish it every success.

THE new Railway Bill which is to apply to all India was sent home for the consideration of the Secretary of State by the last mail.

MR. H. W. J. BAGNELL, C.S., Assistant Collector, Bombay, is appointed to be Inspector of Factories for the town and island of Bombay.

COLONEL STEEL, R.E., who was recently gazetted as Secretary to the North-West Provinces, Government in the Public Works Department, has taken six months' leave.

OF Indian lighthouse lights the one that can be distinguished farthest is said to be that of Allepey at Travancore, which has been seen at a distance of forty-five miles.

LAST year 3,464 cwt. of wool was imported into British India from Thibet. The factories established on the Baree Doab Canal and elsewhere are said to be doing fairly well.

THE Government steamer *Sir William Peel* has been sold privately to the Irrawaddy Flotilla Company. She was repaired by the Flotilla Company last year for Government.

VERY serious fires are reported from Barwani, Central India. The theory is that the bamboos rub against each other and by friction cause numerous outbreaks at this time of year.

DEFALCATIONS by some Madras Railway officials employed on the construction of the bridge over the Pennar river are said to have occurred, and specific charges are being framed.

THE Irrawaddy Flotilla Company have recently completed, at their yard at Dalla, a new stern-wheel steamer called the *Hata*, which is intended for trading operations on the river above Bhamo.

IT is now admitted that the vast and quite needless roof placed over the Tulsī water, at a cost of four lakhs, has knocked the bottom out of the Reservoir and entailed a further outlay of one or two lakhs.

THE Mandalay Railway, when completed, will make the Mandalay Station 445 miles from the Phayre Street Station in Rangoon. The line will probably be open for goods traffic in August, and for passengers by the end of the year.

WE are informed that, at a recent meeting of the Directors of the Darjeeling and Himalayan Railway Company, it was resolved to order at once enough locomotives and other rolling stock to largely increase the goods carrying capacity of the Railway.

THE proposal to erect a row of shops over the transept of the Crawford Market at Bombay, has been rejected by the Town Council, for the good reason that it would not only be unsightly, but would shut out the light, and by interfering with the ventilation, render the market hot and unwholesome.

THE manufacture of machine ice in the North-West Provinces has so far not proved a commercial success, as, at the instance of the judgment creditors in England, the plant of the ice factories of Lucknow, Allahabad, and Agra is in the market. The failure of the Limited Company may pave the way for a profitable business to its successors, as there can be no doubt that, properly managed, the manufacture of ice is a profitable industry.

THE Trustees of the Victoria Public Hall, Madras, have taken over charge of the building from Mr. R. F. Chisholm, the Architect. The Trustees, on their own behalf, and on behalf of the public of Madras, have placed on record their high appreciation of the able manner in which Mr. Chisholm has carried out the construction of the Victoria Public Hall, and given him a cordial vote of thanks for his services."

THE Annual Administration Report on Railways in India, shows that the net receipts in 1887 were Rs. 38,78,758 less than in 1886, while the percentage on capital expended was 5·33 as compared with 5·90. During the year, 988 miles of Railway were completed and opened for traffic, making a total of 14,388 miles open on 31st March last. On the same date the total of sanctioned lines open and under construction, was 16,870 miles.

Letters to the Editor.

[The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

ART SCHOOLS IN CALCUTTA.

SIR,—The introduction of a system of technical education has formed a topic of interest, and has on many sides been strongly recommended, and while pointing out that advanced education as now followed out gives no incentive to independent thought and action in the mind of the Bengali, it should not be forgotten that before launching out into a scheme of technical instruction the basis upon which alone it can be founded securely—*viz.*, the training of the hand and the eye in the elementary processes of drawing, must receive close attention. It is true we have a School of Art in Calcutta; but what purpose does it serve? Is it so constituted that any young man while carrying on his usual studies can obtain instruction in drawing for say three or four hours a week? In order to widen the intellect and extend the usefulness of a student he ought certainly to learn drawing as well and as carefully as he learns writing.

If the Calcutta School of Art stood in close proximity to the schools and colleges which lie in a cluster in College Street, and facilities were offered by the School of Art for instruction at a convenient time, say just before or just after the usual school hours, it would no doubt be taken advantage of. The three buildings now occupied by this institution are utterly unfitted for their purpose, and until proper accommodation is provided, and the new and able Superintendent has better class rooms and appliances, Art training can never occupy the position it should, and the introduction of technical education without it is a clear case of building without a foundation.

The provision of proper accommodation for Art teaching cannot, however, be much longer delayed, and if the Senate of the University, or the Director of Public Instruction would only exert due pressure in the proper quarter, it might be found possible to erect a new building (between the Senate House and the new Hindu Hostel) for the School of Art providing an upper story for regular Art students, and class rooms in the lower floor for elementary pupils, who would attend for an hour or two daily, or as it may be found convenient to arrange.

A. R. I. B. A.

UNFAIR COMPETITION.

SIR,—Why is it that Executive Engineers, when they have the opportunity, always try and start a *workshop* in connection with the works in their division? Do they not know that in most cases private enterprise, especially in large stations and at the Provincial capitals, is fully equal to meeting the requirements of the general public, and at the same time capable of executing all orders from Government Engineers in iron and brass work, and what is more, doing the work in a manner far more satisfactorily than the would-be Mechanical Engineer, whose special knowledge in these matters must be of limited extent. A case in point is that of the Executive Engineer, Special Works Division—and in charge of the A—n C—e, who begs to inform his honored constituents, Presidents of District and Municipal Boards, that he "has arrangements complete at the A—n C—e Works for undertaking castings of all sorts and sizes in iron or brass, and as he has not sufficient work of his own to keep the workmen engaged, he should be glad to receive orders from other places." "Would feel therefore obliged if he could favor him with any orders for any articles requiring cast-iron (*sic*) such as wheel-barrows, rammers, railings, road rollers, mortar mills, etc."

"He will find the charge is very moderate."

Apart from sundry inaccuracies of idiom and English composition the docket just quoted is suggestive of two facts—

First.—The petty establishment is very much in excess of requirements of the work and not commensurate with the importance of the project; or

Second.—The estimate in the first place must have been very extravagantly framed.

Either of the two alternatives point but to one conclusion, *viz.*, that the work might be carried out in a more economical manner. The fact of an Engineer entertaining a large establishment and investing in plant and appliances merely for the sake of indulging in a puerile whim and, what is worse, interfering with private enterprise, would almost justify the Government in considering how far he is qualified to discharge with due efficiency the onerous and important duties entrusted to him. Private enterprise has a great deal to contend against in India, but the evil becomes more accentuated when official abuses of this nature are allowed to go unchecked.

FAIR-PLAY.

"AGRICULTURAL SHOWS."

SIR,—In your last number of INDIAN ENGINEERING I saw a letter from Mr. Jones, State Engineer, Nahan, on the subject of

his sugar-mill, which unfortunately does not appear to have come to the front as it deserves. The Beheea mill has been persistently "cracked up" for years past, and though it has done an enormous amount of good, and is paving the way to an agricultural reform of great importance, it would, were the merits of the Nahan mill more widely known, be completely driven out of the market by the latter machine. Some four or five years, in addition to my other duties—maintaining roads, bridges, etc.—I was called upon to Boss an "Experimental Farm," and amongst the details to which my attention was called, I was directed to experiment and report on agricultural machines and implements for the information of Government. Sugar-mills were of course included in this catalogue, and the various types in use were submitted to repeated and searching tests. The two which found most favor with the Zamindars were:—

(i.) The Beheea (ii.) the Nahan; and after considerable experience I was decidedly in favor of the Nahan. The two great points in its favor being (a) it invariably gave a higher percentage of juice per 100lbs. of cane crushed, and the (b) juice expressed was always found to present a greater density, the average being 1° Beaumé in favor of the Nahan mill,—as is doubtless well known, each degree of Beaumé denoting the presence of 1lb. 13oz. 6drs. of dry sugar per 100lbs. of juice. The machines were not confined to crushing one description of cane, but the experiments were conducted on the four different varieties grown in this part of India, *viz.*:

i. Chan, ii. Ekar, iii. Dhauru, iv. Kāhā. Nos. i., iv. are considered the best, as they are more juicy and richer in saccharine matter.

What was and perhaps always must remain, the great defect in the Beheea mill, was the method by which the rollers are screwed up and adjusted so as to obtain a good pinch or bite, and extract the maximum amount of juice from the canes as they pass through the mills. The set screws which worked through the upper and lower transoms and tightened up the brasses in which the gudgeons worked, sometimes broke off short in the transoms and had to be drilled out, sometimes as the brasses were down, and it was not always an easy matter to impress on the natives using these machines the importance of keeping them well lubricated, the result being unequal strains on upper and lower gudgeons, a fracture sooner or later ensuing; moreover, in more than one instance I remarked that due to defective material the rollers did not present the appearance of a true cylinder, but the surfaces becoming horizontally grooved and striated to a very marked degree, which of course detracted from their efficiency.

Now, in the Nahan mill, the method by which the bite is increased, or the spaces between the rollers increased or diminished, is so very simple, that with one motion of the hand the desired amount of alteration can be effected, and perfect parallelism between each roller maintained.

The iron frame work and cheeks, in which the rollers of the Nahan mill work, are points of superiority which the Beheea mill does not possess. I may also add that I consider that in the Nahan mill the arrangements for lubricating the bearings are better than in the Beheea.

I have no wish to disparage or unduly depreciate the invention of Messrs. Mylne and Thompson, as it is a machine which has done an enormous amount of good, and one of the most valuable-labor saving implements ever yet presented to the zemindar, but I may add that every season, as long as the Experimental Farm above alluded to was in existence, I used to be deluged with applications from zemindars for the loan of sugar-mills (they were given out free of charge to the zemindars and returned at the end of the season early in March for repairs and refitting) and as soon as the merits of the Nahan mill became known the zemindars would not look at the Beheea, but every application was for the "Loha-kā Beheea," as they called it, on account of its iron framing, because, as the *vox populi* had it, it was (a) easier to work, and (b) it expressed a juice containing more "kann," vernacular for saccharine matter. Such at least was the unbiassed verdict, and though perhaps not quite free from "some shallow spirit of judgment," I am bound to concur in the same verdict.

S. P. Q. R.

DISTRICT ENGINEERS IN BENGAL.

SIR,—By the recent rule framed by His Honor the Lieutenant-Governor, or more properly by his advisers in command of block No. 3, Writers' Buildings, and published in yesterday's *Calcutta Gazette*, a death-blow has been struck at the root of all chances of improvement of the prospects of the outsiders already in service as District Engineers in Bengal.

The object of this rule is the carrying out of a far-sighted policy, the beginning of which has just been made behind the screen, but as that was contrary to all the existing rules in force, the necessity of the publication of the one under notice has been found indispensable with a view to give publicity and enlightenment to the outside world. As to the legality of the procedure, the weak have always to put up with difficulties, and the District Engineers in Bengal, who are mostly natives, and purely private servants of a

body of whimsical masters, cannot possibly be expected to raise up a cry in opposition to any measure which the Government may choose to frame under the influence of serving a selfish interest.

It may be questioned as to what selfish motive can the Government have? But I will come to it later on.

District Engineers, whose misfortune it has been to be the natives of the country, are with one or two exceptions in the receipt of salaries varying from Rs. 250 to Rs. 400 per month, and the work they have to perform is nothing short of an Executive Engineer in the P. W. D. (whose improvements and prospects are of course a hundred times better).

The new law which provides for the extension of Local Self-Government in Bengal also makes provision for the appointment of District Engineers with salaries which will be subject to variation from time to time. This variation has been very far from on the credit side of the District Engineers, as experience has shewn that in making new appointments the Boards have fully made use of the power by inviting tenders for men at reduced salaries, and they have succeeded in getting them.

If this is a move in the right direction for effecting economy under the full encouragement from Government, does it not stand to reason that Government in its present financial pressure should follow the same example and get men on lower salaries than what the Engineers in the P. W. D. are getting? That a poor salary brings along with it a low scale of morality is not a deniable fact, and can it not be inferred that Government by expecting people to undertake grave responsibilities on low salaries holding out no chance of increase is but giving countenance to the gradual rise of weakness of purpose in a body of public servants? With the growth of years their wants will increase, but not their income, and how are they to make two ends meet? They will do it somehow like the Head Constable in the Bengal Police, who, though drawing as pay only ten rupees, is expected to keep a pony which costs him Rs. 10, and he does it, but surely not at his own expense!!!

This is not unknown to Government, and still it is tolerated. However, I am afraid I am digressing from my point.

The recent rule provides that in case where an officer of the P. W. D. is to be a District Engineer, the procedure applicable to the case of outsiders is not necessary; this means in plain words that any post of District Engineer whose pay will be above the ordinary scale as is drawn by present outsider native District Engineers, or where Government may be pleased to transfer Provincial Works to Boards, it will no longer be their fate to look for.

The recent appointment made by Government in the District Engineer of Hooghly establishes the truth of my statement. A native Executive Engineer from the P. W. D., with whom evidently they were at a loss to make out what to do, has been thrust upon the District Board of Hooghly, where before there was a retired Executive Engineer of the P. W. D., and whom the District Board wanted to replace by a lowly paid officer. The Government wanted to transfer, and has done so, since 1st April, certain provincial roads to the charge of the Board, and as they were to be supplied with grants-in-aid for the maintenance of those roads, insisted upon the Board to take an officer of the P. W. D., as otherwise the sanction for an outsider as District Engineer would not be permitted.

This had led to the appointment of a P. W. D. officer as District Engineer of Hooghly, and in the absence of any authorised rules for the procedure, the publication of the recent rule has been found imperative, as for want of this the appointment of this officer has not yet appeared in the local *Gazette*.

By this appointment has not Government done grave injustice to the other District Engineers? Is there not any one among them worthy of being able to hold charge of the Trunk road?

What is there extraordinary on that road that it would be doing an act of sacrilege as it were by allowing it to be touched by a "pariah" District Engineer?

If so, what is then the necessity of framing such hard restrictions in the appointments of District Engineers in general?

If they do not enjoy the confidence of Government of being able to be trusted with Provincial Works, there ought to be a clause in the Act openly explaining that when such works are to be made over to the Boards, these District Engineers shall have to make room for officers of the P. W. D. Alas! poor District Engineers of Bengal! With great difficulty some of you after a hard struggle in an unemployed life have succeeded in obtaining District appointments, but the day is not distant when you shall have to submit to the caprices of Government, and yield your places to men from the regular P. W. D. when the interests of the Government will be at stake.

Before long the development of the policy just begun by Government will have effect, and the few native Engineers now in the list of the Government of Bengal will gradually be placed in charge of District works along with the transfer of Provincial Works to the District Boards.

While by such transfers the outsider District Engineers will be great sufferers, it will no doubt be hailed with satisfaction by the junior *Assistant* Engineers from Cooper's Hill, by whom these Members of the service are looked upon as proving a great block to their prospects in the Department, which has practically been, and will before long completely be, their monopoly.

R. M. B.

CALCUTTA; June 7, 1888.

Literary Notices.

"IMPROVED SYSTEMS OF CHAINING FOR LAND AND ENGINEERING SURVEYS." By William Munn Thompson, M. A., B. E., Assoc. M. Institute C. E. Pro Institute C. E. 1888.

THERE are two methods of chaining described in this pamphlet adapted respectively for working in the heavy traffic of a crowded city and in the most open country districts where there is nothing to interfere with the use of long lengths of steel bands. Of the two systems, the first had its origin in the necessity that existed of having some good, quick and reliable method for measuring traverse and working lines in carrying out the detail trigonometrical and sewerage survey of Sydney. Here where all details in the shape of buildings, existing lines of drains, watercourses and property boundaries had to be shown with great accuracy the old system of chain surveying was found unsatisfactory and had to be abandoned.

The chain was done away with and a steel riband $\frac{1}{8}$ inch wide and $\frac{3}{4}$ inch thick was substituted and this riband was furnished with adjustable handles so that its length could be made to agree with the standard laid down at Sydney Observatory. To obviate the source of error which exists when the back end of the chain is held by hand, a contrivance was designed whereby the whole weight of the back-chainman might be applied to resist the strain. It consisted of a board 18 inches long by 14 inches broad on which was nailed a leather pad to act as a cushion for a man's knees; to the front of the board was attached a brass slide worked by a large milled-headed screw and capable of a forward and backward movement. The front end of the slide terminated in a hook to which the chain was fastened, the end of the chain having a special handle with a loop attachment into which the hook worked; the handle was also furnished with a small steel knife-edge. Again to get rid of the error arising from the application of different tensions to the chain, a small spring balance (capable of registering a pull of 30lbs.) was placed on the leading end of the riband and a pull of about 16lbs applied to the chain. A small plum-bob was suspended from a hole in the forward end of the riband and the distance of its point from the knife-edge on the back end was accurately adjusted to the Observatory standard. The average rate of progression by this method is from 20 to 25 chains per hour, and the system would appear, from the tables inserted, to give excellent results.

In the second system, that of chaining by means of a long wire, the chain can be used in either of three different ways:—1st with constant tension and supports at short intervals; 2nd with constant tension and supports only at the extremities in which case there is a correction for sag; 3rd with varying tension and supports only at the extremities. For either of these methods a long light steel riband $\frac{3}{16}$ inch broad and of about 1lb to 350 links should be used, and the most convenient way is to have it made in 1 chain lengths fastened together so as to be able to lengthen or shorten the chain. The most convenient length for ordinary purposes is 5 chains as it gives the best results and involves less calculation for corrections. In using these ribands the angle of elevation or depression is taken with a theodolite and the measurement is made with the riband from the horizontal axis of the instrument to the point observed, the horizontal distance being afterwards deduced. There is not much to choose between the three methods. The first method presents the difficulty of correctly lining the support but involves less calculation than the second and third which are better adapted for rough and broken country. The second requires correction for sag and in the third the tension must be adapted to the lengths but tables are given in the pamphlet whereby the labour of computing the correction for sag and the proper tension is reduced to a minimum. Although these methods of chaining have not been employed in this country similar chains have been made use of principally as chains of reference, and the long chain was used in the Survey of the Andaman Islands as a check on the measurements of the base-lines.

General Articles.

EDEN SANITARIUM, DARJEELING.

THE objects of the Sanitarium are thus described in the memorandum of the late Lieutenant-Governor, the Honourable Sir Ashley Eden, appointing a Committee to decide upon the site of the new building.

"Now that the tramway has been brought into Darjeeling, and that sanitarium is placed in direct and easy communication with Calcutta, and with most of the civil stations of Bengal, and now that tea planters from the unhealthy Dooars and the Terai can reach this station easily and without exposure in a few hours, the question of providing a good, well organized European hospital for the comfortable reception of patients and convalescents from the plains, forces itself upon the consideration of Government.

"I have already received representations regarding hospital accommodation for sick persons and convalescents connected with the Eastern Bengal Railway, the Northern Bengal Railway, and the Darjeeling Tramway; and it appears that if nothing else be done, some arrangement must at once be made, in communication with the managers of those lines, for supplying a great and growing need of this sort. But as Darjeeling increases, —and it is now increasing daily—we shall have to provide hospital accommodation for the permanent residents of the station and district. There are the tea planters and their assistants scattered about all over the district, some of them placed in very unhealthy situations. Cases in which young men are brought in suffering from fever of a severe type for medical attendance are very common, and a difficulty is frequently found in providing them with accommodation during their illness. The hotels and boarding houses are generally full, and a sick person is not always a welcome inmate in a public establishment of that sort; and it is feared that many useful men have lost their lives in the Dooars and the Terai, who would at once have come up for treatment, if a comfortable hospital existed for their reception. Then, again, there are many cases of persons residing in outlying plantations, who desire attendance during their confinement, who can only obtain it at an enormous expense, altogether beyond their means, and who are not within reach of the Civil Surgeon; and cases are not unknown in which it has been found impossible to procure accommodation for such cases here on any terms.

"But besides these, there are frequent cases in the mofussil stations of persons pulled down after severe sickness or suffering from obstinate disease, who are unable to take the change to sea which richer persons could afford, but for whom a change and careful medical attendance are absolutely necessary. There are also persons who could undergo operations in the cool climate of the hills, which they could not bear in the heat of the plains. Lastly, there are patients convalescing in the Calcutta hospitals, to whom a change to a convalescent ward in Darjeeling would be of the utmost importance.

"It therefore seems to me that, as a European hospital has to be built, we should not keep in mind only the requirements of Darjeeling, but of the province generally.

I do not wish the hospital to be a charity hospital. It should pay its expenses, the building having once been provided and equipped. I am disposed to give a grant from Provincial services of Rs. 50,000 to Rs. 60,000 for the purpose of establishing the hospital provided such a hospital is erected as shall afford accommodation to invalids from all parts of the Lower Provinces. The fees should be so fixed that they afford a reasonable prospect of the hospital covering its expenses."

The foregoing was written in June 1881, and the Sanitarium was completed in August 1882 and ready for occupation in the following October.

The site selected is a small detached hill in the centre of the station, the top of this hill has been cut down and a level space of about two acres obtained. In a sanitary point of view this site is perfect, for on all sides but one the hill falls away steeply.

The building with its out-offices, on which nearly Rs. 1,70,000 was expended by Government before it was completed, is ornamental and forms one of the most striking features of the station. The shape is that of three sides of a square, the centre or front block being for the accommodation of first class patients, the two wings for second and third class patients respectively. The building is double-storied and separate dining and sitting-rooms are provided for the use of the patients of each class.

For first class patients sixteen separate bed, dressing and bath rooms are provided, each set of rooms being entirely private. On the upper floor there are a sitting room and a dining room for ladies, and on the lower floor the same common rooms for gentlemen.

The second class wards are divided into small rooms each containing two beds, and provide accommodation for 20 patients in all. On each floor there are separate sitting and dining rooms, so that one floor can, if required, be given up for female patients.

The third class patients are accommodated in a general ward containing ten beds on each floor, or twenty beds in all.

For them also there are separate sitting and dining rooms on each floor.

The advantages offered by the Sanitarium of a change to the hills and treatment in a comfortable semi-private hospital during illness or convalescence, or when suffering from the effects of long continued residence in the plains, are of inestimable value.

The outer walls in the lower storey are built of rubble stone masonry in lime mortar; those in the upper storey, and all the partition walls consist of framing of local timber filled in with brick nogging, plastered on both sides.

All exterior woodwork exposed to the weather is of Moulmein teak and that in the remainder of the building, such as posts, post plates, floor joists, and roof trusses, rafters, &c., &c. is of local wood.

The roof is covered with Moulmein teak shingles, secured to teak battens.

The doors, windows, roof ventilators, barge boards, eaves boards, ornamental gables, spear heads, finials, verandah railings, stairs, and all joiner's work are of teak wood.

The Chimney shafts are of terra cotta.

There is a stone ware perforated damp proof course in all the walls, immediately below the floor joists.

The building was designed by Mr. E. J. Martin, M. Inst C. E., F. R. I. B. A., late Architect to the Government of Bengal. Messrs. Mitchell and Rumsey were the contractors for the work.

DRAINAGE OF TOWNS BY OPEN DRAINS.

By H. W. HUGHES, C.E.

IV.

THE table subjoined gives the velocity and discharge of open drains of the sections given in the plates running full at inclinations of from 1 in 50 to 1 in 2,000.

From an inspection of these tables, and bearing in mind the limits of velocity fixed, we find—

(i.) That in 6" drains running full they may be laid with even a steeper fall than 1 in 50, but they should not have less than 1 in 150 feet.

(ii.) That in 9" drains the inclination should not exceed 1 in 100, nor should it be ever less than 1 in 250 under any circumstances.

(iii.) That in 12" drains the inclination should not be more than 1 in 150 nor less than 1 in 500.



The "STAR" Press, 19, Lall Bazar, Calcutta

NG.

80 Feet



E. J. MARTIN,
 Superintending Engineer
 on special duty.

TABLE No. *Velocity and discharge of curved versus shaped drains—Running full.*

Fall 1 in	Class I.			Class II.			Class III.			Class IV.			Class V.			Class VI.			Class VII.		
	Discharge.			Discharge.			Discharge.			Discharge.			Discharge.			Discharge.			Discharge.		
	Velocity per sec.	C. F. per sec.	Gallons per hour.	Velocity per sec.	C. F. per sec.	Gallons per hour.	Velocity per sec.	C. F. per sec.	Gallons per hour.	Velocity per sec.	C. F. per sec.	Gallons per hour.	Velocity per sec.	C. F. per sec.	Gallons per hour.	Velocity per sec.	C. F. per sec.	Gallons per hour.	Velocity per sec.	C. F. per sec.	Gallons per hour.
50	4.93	0.888	19,980	6.75	2.568	57,780	8.84	6.476	145,710	5.12	8.040	180,900	5.46	11.466	257,985	5.75	15.870	357,075	5.75	15.870	357,075
100	3.50	0.643	14,467	5.31	1.817	40,880	6.97	4.950	111,325	4.79	7.520	169,200	4.70	9.870	222,075	4.70	9.870	222,075	4.70	9.870	222,075
150	3.00	0.540	12,150	3.88	1.477	33,234	5.09	3.614	81,315	4.45	6.986	157,185	4.30	8.887	211,207	4.30	8.887	211,207	4.30	8.887	211,207
200	2.50	0.457	10,282	3.44	1.308	29,430	4.52	3.210	72,225	4.22	6.635	149,062	4.05	8.503	191,362	4.05	8.503	191,362	4.05	8.503	191,362
250	2.20	0.396	8,910	3.00	1.140	25,650	3.94	2.800	63,000	3.82	5.997	134,932	3.66	7.546	129,285	3.66	7.546	129,285	3.66	7.546	129,285
300	2.77	1.052	23,625	2.77	1.052	23,625	3.64	2.584	58,140	3.66	5.746	129,285	3.44	7.224	162,340	3.44	7.224	162,340	3.44	7.224	162,340
350	3.50	1.350	30,375	3.50	1.350	30,375	3.34	2.371	53,347	3.34	5.463	122,917	3.15	6.804	153,090	3.15	6.804	153,090	3.15	6.804	153,090
400	3.00	0.900	22,500	3.00	0.900	22,500	3.16	2.243	50,467	3.08	5.321	101,722	2.96	6.468	149,310	2.96	6.468	149,310	2.96	6.468	149,310
450	2.50	0.675	18,375	2.50	0.675	18,375	2.98	2.115	47,587	2.83	4.945	111,262	2.88	6.321	142,222	2.88	6.321	142,222	2.88	6.321	142,222
500	2.16	0.583	16,416	2.16	0.583	16,416	2.79	1.981	44,572	2.70	4.788	107,730	2.80	6.321	142,222	2.80	6.321	142,222	2.80	6.321	142,222
550	2.05	0.540	15,525	2.05	0.540	15,525	2.66	1.888	42,480	2.66	4.647	104,557	2.45	5.145	115,762	2.45	5.145	115,762	2.45	5.145	115,762
600	1.90	0.495	14,400	1.90	0.495	14,400	2.54	1.803	40,567	2.54	4.521	101,722	2.42	4.452	100,170	2.42	4.452	100,170	2.42	4.452	100,170
650	1.75	0.450	13,275	1.75	0.450	13,275	2.44	1.732	38,970	2.44	4.396	98,110	2.42	4.452	100,170	2.42	4.452	100,170	2.42	4.452	100,170
700	1.60	0.405	12,150	1.60	0.405	12,150	2.35	1.668	37,530	2.35	4.281	96,110	2.42	4.452	100,170	2.42	4.452	100,170	2.42	4.452	100,170
750	1.45	0.360	11,025	1.45	0.360	11,025	2.25	1.597	35,932	2.25	4.166	94,110	2.42	4.452	100,170	2.42	4.452	100,170	2.42	4.452	100,170
800	1.30	0.315	10,000	1.30	0.315	10,000	2.16	1.507	34,335	2.16	4.051	92,110	2.42	4.452	100,170	2.42	4.452	100,170	2.42	4.452	100,170
850	1.15	0.270	9,075	1.15	0.270	9,075	2.07	1.426	32,738	2.07	3.936	90,110	2.42	4.452	100,170	2.42	4.452	100,170	2.42	4.452	100,170
900	1.00	0.225	8,150	1.00	0.225	8,150	1.98	1.345	31,141	1.98	3.821	88,110	2.42	4.452	100,170	2.42	4.452	100,170	2.42	4.452	100,170
950	0.85	0.180	7,225	0.85	0.180	7,225	1.89	1.264	29,544	1.89	3.706	86,110	2.42	4.452	100,170	2.42	4.452	100,170	2.42	4.452	100,170
1,000	0.70	0.135	6,300	0.70	0.135	6,300	1.80	1.183	27,947	1.80	3.591	84,110	2.42	4.452	100,170	2.42	4.452	100,170	2.42	4.452	100,170
1,500	0.35	0.068	3,150	0.35	0.068	3,150	0.90	0.591	13,974	0.90	1.795	40,567	2.42	4.452	100,170	2.42	4.452	100,170	2.42	4.452	100,170
2,000	0.20	0.040	1,800	0.20	0.040	1,800	0.54	0.354	7,965	0.54	1.183	27,947	2.42	4.452	100,170	2.42	4.452	100,170	2.42	4.452	100,170

- (iv.) That in 15" drains the slope should not be more than 1 in 200 or less than 1 in 750.
- (v.) That in 18" drains the greatest allowable inclination is 1 in 300, and the lowest *running* full 1 in 900.
- (vi.) That 21" drains should not have a steeper fall than 1 in 350 nor less than 1 in 1,500.
- (vii.) That in 24" drains the slope should not exceed 1 in 450 or be less than 1 in 2,000.

These figures are supposing all the drains to be constantly full, but in practice this will be seldom so, and the minimum slopes should be somewhat steeper than above given; discharge for drains of the same dimensions flowing half full and will be of assistance in deciding this question.

Where only a gentle fall is available, a drain of larger section should be provided, but on the other hand it is no use to construct a large sized drain unless there is sufficient drainage to fill it, as otherwise a sufficient velocity will not be maintained, this question of fixing the fall and cross-section of drains is one that calls for much care and patience, as on its being properly done the success of the scheme mainly depends; for although excellent arrangements may be made in other respects if the system fails in this it can never be thoroughly efficient.

Flushing arrangements for open drains.

The operation of flushing consists in letting a quantity of water into the drain at certain points of its course, with a sudden rush so as to sweep away all impurities adhering to the drain. The efficiency of flushing depends

1. On the quantity of water used.
2. On the duration of the rush.
3. On the arrangements made for suddenly releasing the water.

The first two points may be taken together, as the duration of the rush naturally depends on the quantity of water.

As a rule the water should be led by pipes to the upper end of every drain, and be let into it under pressure, the quantity of water ought to be enough to maintain a constant flow for at least half an hour with the drain at the head running full, as the smaller drains discharge into the larger ones the quantity of water would be greatly augmented by the time it reached a point where the drain was of any size, but it might be advisable to have additional flushing arrangements in certain places and every case would require to be decided according to the particular necessities of the locality.

With regard to the third point, generally the quantity of water let into the drain at the head would insure a good rush of water there.

At other points it might be necessary to provide a series of self-acting sluices to lead up the water to a certain depth in the main drains before it was let out.

This paper does not pretend to be an exhaustive treatise on the subject and only general principles are touched upon. Details of pumps, pipes, sluices &c., &c., are therefore not given, and moreover every locality has its own particular requirements and the Engineer would naturally decide such minor details accordingly.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK
XXXIV.

Items per 39 s. ft.		No. or Quantity.	Rate.	Amount.	Total.
(1)		(2)	(3)	(4)	(5)
<i>Labor.—</i>					
Carpenters	No. ...	20			
Coolies	" ...	4			
Carts	" ...	3			
Sundries	" ...	...		
<i>Materials.—</i>					
Teak wood, with waste	c. ft. ...	8.65	Variable.	Do.	Do.
Iron work	lbs. ...	11.4			
Sundries	...	...	
Petty Establishment	...	...	
Total per 39 s. ft.	...	...	
and per s. ft.	...	...	

LIMES AND CEMENTS.

II.

Of poor lime sufficient mention has been made and I now propose discussing hydraulic limes. These may be defined as limes containing after burning enough free quicklime to allow of an appreciable amount of slaking taking place. The amount of free quicklime present will regulate the rapidity and intensity of the slaking action. The presence of clay in the stone calcined regulates the amount of slaking. If there was in the original stone sufficient clay to unite with all the lime under the action of heat, then no slaking action will take place, and we shall have a cement. If a little free lime is left then an eminently hydraulic lime is the result, if a larger quantity of free lime is found after calcination then a fairly hydraulic lime ensues, and if there is very much lime and a very little clay then the class of slightly hydraulic limes is attained. If clay or soluble silica or magnesia or certain alkalies are present in the limestone, then we may look for the production of a hydraulic lime after calcination. Of these the most important is clay. It has the power of reducing the slaking action and of enabling the lime in combination with it to set hard under water and without the access of air. From 8 to 27 per cent. of clay in combination with from 92 to 73 per cent. of carbonate lime is necessary in stones required to produce limes ranging from the slightly to the eminently hydraulic. When lime is burnt in the presence of clay which, as a rule, is a chemical combination of alumina, silica and iron, and probably some soda or potash, there results after slaking hydraulic limes. These last three favor the formation of silicates and aluminates of lime and help them to be produced at a lower temperature than could be done without their presence. In fact, they act as fluxes. The silicate of lime is formed with less heat than the aluminate of lime. When the burning has been completed, these compounds in the presence of a little free lime and water unite with one another to form further compounds which have the power of setting under water. The amount of burning depends upon the kind of stone. Where alumina predominates there a greater amount of heat will be necessary, than where less alumina and more silica is found. In this country one finds a very remarkable hydraulic stone of very variable combinations of clay and lime in what is known as kunkur. The hardest kinds of kunkur, such as those of most service in road making, have not more than 10 per cent. of clay, and probably less. This is best and most easily ascertained by watching the slaking action after calcination, and the amount of heat given off, the increase in volume, and the rapidity of the action. If slightly hydraulic one will look for results considerably less than are found in slaking fat limes, and as the hydraulicity increases so the slaking intensity diminishes. In burning nodules of kunkur rich in clay, and afterwards slaking and screening them, it will be remembered that very often a large quantity of unslaked nodules are left on the wrong side of the screen. This shews that they are not hydraulic limestones, but must be classed as cements, because they have sufficient clay to chemically combine, under the influence of heat, with all the lime in the stone and consequently there is no free lime left to cause the slaking action necessary in hydraulic limestone. In such a case, if these unslakable nodules be ground up in a mortar mill and mixed with the slaked lime, a very hard mortar will be obtained. There is a theory that the mixing in one pan of lime, cement and soorkee or sand will form a mixture, part of which sets quickly and part slowly, and that the two settings at different times are injurious to the strength of the masonry. This may be so, but I have not found it. There seems to be a similarity between these kunkur nodules with excess clay in combination, and the nodules found in various parts of Europe from which natural cements are formed. With mortar made from fat lime and sand or ashes, the setting action is so slow that there is practically no harm in mixing a large quantity and using yesterday's mortar for to-day; but with hydraulic mortars the case is different and they should be

made fresh and fresh. The proportion of sand ashes or soorkee to be mixed will depend on circumstances, and on the kind of lime in use. The lime should be slaked not long before making the mortar, as it is stronger in this case. The general specification given is, 1 measure of quicklime in lump to be added to 2 measures or more of sand or ashes. Where the lime is only slightly hydraulic, it will be necessary to use soorkee in place of the sand, say 1 quicklime to 2 soorkee; where fairly hydraulic a good specification would be 1 quicklime, 1 sand and 1 soorkee. Thus the first mixture quoted could serve for good hydraulic and eminently hydraulic limes. In every case the ingredients must be thoroughly incorporated and bricks soaked and masonry kept wet for 3 weeks or a month.

Another method of gaining hydraulic limes is by the calcination of carbonates of magnesia. These, too, give off carbonic acid and water, but they differ from the carbonates of lime in one remarkable respect; when water is thrown on the calcined lumps they do not slake, but form a paste with the water which has a great tendency to set. They are of great value when obtainable. These magnesian limestones are of great use, and extensively introduced into the formation of Scott's or Selenitic Cement, which is made either by the passing of fumes of sulphur through hydraulic limes or by the addition of sulphate of lime in a finely powdered condition to the hydraulic lime. The amount added depends on the hydraulicity of the lime used. The average amount is some 5 per cent.

So far as regards natural cements what has already been said about some of the kunkur limestones goes to prove that in some parts of this country there are kinds of kunkur, nodular in form, as a rule, which possess the necessary amount of clay to unite with all the lime and so prevent slaking when water is added after calcination. Such stones are natural cement producers. Where the necessary amount of clay is not found in the hydraulic limestone to form cement, it would be quite possible, with good machinery, to pulverize the stone, and mixing it with some suitable clay in tanks constructed for the purpose, to thoroughly incorporate the clay and crushed stone and so introduce into intimate connection the lime and clay. This mixture being allowed to settle, and excess water run off, the creamy sediment is left to evaporate till balls can be made out of it. These balls are reburnt and after a proper amount of calcination finely powdered when a cement will be the result. Concerning the amount of calcination necessary, the materials used will serve as a guide. The natural cement-bearing stones of Europe, as a rule, contain either iron or soda or potash, and sometimes all of these in minute quantities, and their presence will necessitate a burning at a low temperature only. Such cements set very quickly, but are never very strong. On the other hand, if the hydraulic limestone spoken of above contains only lime in amalgamation with silicate of alumina, and the clay added be fairly pure silicate of alumina, then the amount of heat necessary will be excessive. We know that it is only at very high temperatures that lime and alumina have sufficient attraction for one another to chemically combine and form aluminate of lime. After this for the aluminates and silicates to combine themselves and form other compounds which have the power of setting hard in the presence of water, more heat is required. In the case of Portland cements of the best kind the stuff is burnt up to the point of vitrification, *i.e.*, it only just escapes being vitrified. Cements so produced are slow setting, but very hard and good. Experiment is the great need and indefatigable exertion. There are hundreds of Government servants in the Department of Public Works who have rare opportunities of making cements, or at all events of improving the lime used in mortar. What is meant to be understood is the taking of certain quantities of limes of various kinds and the mixing them with varying quantities of clays, and after intimate incorporation the burning of these at different temperatures. Then will come the

pulverizing and the sifting and last of all the experiment! If we all had a trial at this some one would undoubtedly exclaim "Eureka" and make tracks for the India Patent Office. Cement has been made in this country and was not a financial success. But that is no reason why some one else should not make money out of it now. Perhaps this is being done. The object of this article is not to attempt to instruct, but to try and stimulate men to the making experiments to improve the lime and cement mortars of India.

NO—SAM.

NOTES FROM HOME.

(From our own Correspondent.)

A VERY interesting paper was recently read by Mr. Walton before the Civil and Mechanical Engineer's Society on Railways for rural and undeveloped districts. Taking the receipts for purely agricultural lines at from £7 to £10 per mile, Mr. Walton set himself the task of showing that a line could be constructed to give a reasonable remuneration on this low revenue taking the expenses at 50 per cent. He gives as a model a line of something over 11 miles, the total cost of which he puts at £41,154 or £3,614 per mile. In this estimate, land is put down at £6,833. There are, however, very few localities in this country where land for an eleven mile line could be got for this money. Indeed, the estimate is really a low estimate for a tramway on ready made roads. The paper nevertheless is full of useful hints on the subject and should be read by all interested in the construction of light railways in rural districts.

A House of Lords Select Committee last week after a long inquiry threw out the Glasgow Subway Bill authorizing the construction of subways six miles in length to be worked with tram cars in Glasgow.

The London and North-Western Railway have decided upon a somewhat novel experiment with regard to their Canal traffic. The Company own the Shropshire Union Canal, and they have determined to try the effect of having locomotive engines to draw the Canal boats instead of horses. Orders have been accordingly given for the construction of several engines of small pattern to run on sets of rails to be laid alongside the Canal. New Canal boats are being built. The experiment will be made between Chester and Shrewsbury.

After a long period of "short time," notices were last week posted in the London and North-Western Railway Works at Crewe, intimating that the workmen would be required to work on Saturdays in future. This notice affects over 6,000 men. Since September the works have been closed on Friday evening until Monday.

An official communication has been received at Crewe that the Duke of Cambridge will visit that railway centre on the 9th of June to open the Queen's Park, the gift of the London and North-Western Railway Company to Crewe and also to review the newly formed battalion of Railway Volunteer Engineers.

From Duncan's Tramway Manual just published, it appears that the working expenses of the tramways of this country are about 75.5 per cent of the gross receipts and the net earnings are equal to about 5½ per cent on the capital expended. On the Railways of the United Kingdom the working expenses are 52 per cent of the gross receipts and the net earnings are equal to 3.99 per cent on the capital expended. The average cost per mile of Railway is £42,848 while for the tramways the cost is £14,825 or about one-third that of the Railways.

The London Chatham and Dover Railway Company's new Channel Steamer *Express* has made 18 knots per hour on the measured mile, steaming at half speed this being the highest record. She will probably be able to cross the Channel in a little over fifty minutes.

It has been definitely determined to light Bristol Cathedral by electricity, and the necessary orders have been given for the work: the special condition of the contract being that the appliances shall in no way interfere with or damage the walls, arches or columns along which the electric lighting will run.

M. Mascart has conducted a number of experiments before the French Physical Society with a view to show the

possible risk of fire attending electric lighting. With regard to the danger of fire from electric lamps, the globes enclosing candle arc lamps, and incandescent lamps of 32 candle power were wrapped by the lecturer in light green tarlatan stuff, cotton, wool and similar inflammable material. At the end of 20 minutes no carbonization of some of the materials was traceable, but in two minutes the gummed wadding in which 2 lamps had been wrapped burst into flames and the lamps broke. In one and half minute an old piece of theatre scenery placed in contact with a lamp began to burn without flame, and in six minutes a cap of cotton and black velvet placed over an incandescent lamp was carbonized.

The Surveyor of Beckenham's Report on Oil Lighting has some interesting figures relating thereto. He states that he had received two definite offers to light the district with oil. The Defries Safety Lamp and Oil Company offered to maintain, keep in repairs, light and find oil, &c., for the whole of the district from sunset to sunrise for one or more years at £2-10 per lamp per annum, or at £3 for a district where there were only 77 lamps. The second offer was similar. They estimated that if the 77 lamps were lighted with oil, the saving would be £53-18 per annum. But the majority of the Board was unfavorable to the oil system.

The clause in the G. W. Railway Bill which authorized the Company to sell the water of the Severn Tunnel Springs at Sudbrook within the Newport Water District has, in view of the opposition on the part of the Newport Water Company and the Town Council, been abandoned and struck out of the Bill.

A representative meeting has been held at Dolgelly, Wales, to take steps in order to bring pressure upon the Government to reduce the Royalty charges on gold and silver mining.

Another discovery of gold has been made in North Wales which promises to eclipse the possibility of Mr. Morgan's famous mine near Dolgelly. Quartz has been found at Festiniog about 30 miles from Dolgelly which, according to the report of Mr. Lowe, the public Analyst of Chester, produced 5 ounces of gold to the ton of quartz. The *Chester Chronicle* says this extraordinary rich find has created much excitement in the neighbourhood.

Twenty-three candidates presented themselves at the recent examination held by the Association of Municipal Engineers in London. Of these, fourteen satisfied the Examiners and were granted their certificates of competency by the Council of the Association. The next examination will be held in London in October.

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

THE American Electric Manufacturing Company have just constructed a new and powerful dynamo. The Company's Electrician and Mechanical Engineer, Mr. James J. Wood, is really the designer and constructor of the machine. This dynamo has recently been tried to test its strength and capacity, and is perhaps the most powerful dynamo in the world in respect to arc lighting. It is not only wonderful in its great capacity, but in the perfect automatic manner of its regulation. Its weight completed is 3,800 pounds. Of this 2,000 pounds is cast-iron, 750 pounds wrought-iron, 150 pounds composition and 900 pounds of copper, 200 pounds of which latter are on the armature.

At a speed of 875 revolutions per minute this dynamo requires 41 horse-power to produce a current of 68 amperes at 4,100 volts, giving an output of 27,780 watts in the commercial circuit, or 37.3 electrical horse-power and 88.8 per cent. of commercial efficiency. This is a very high showing for electric arc light machinery.

Your correspondent a short time ago visited the works of the American Electric Company at their factory in New York City, to see this dynamo work. The dynamo was run on greatly varying loads, without any change of speed. It was overloaded by placing 95 lamps in circuit, without any apparent diminution in the brilliancy of each lamp, though they must have given less candle-power than the 1,200 nominal for which the machine was constructed, that number being the usual standard for street lighting. To illustrate the range of the machine's capacity 5 lights were turned off at a time, then 10, and then 25, until all save 1 were extinguished.

This was repeated several times, without any perceptible change of power of the single lamp that remained burning. The dynamo was then placed on short circuit, or all lights off, without the slightest danger from over heating, there being little or no sparking at the commutator, so perfect was the operation of the regulator. The lights were then rapidly turned on, the regulator responding instantly as the number of lights were increased, until the load was again at a maximum. The experiment showed the vast capacity of the dynamo and the completeness with which such a small regulator held the giant machine under control, increasing or decreasing the power as the occasion called for it.

Colonel Henry Flad, Past President, Am. Soc. C. E., and President of the Board of Public Works, and one of the foremost Civil Engineers of America, has recently given a very strong opinion in favor of electric as compared with cable roads.

Colonel Flad recognizes the advantages of the cable system, being a very great improvement over animal-power, and believes that its application will soon be confined to the operation of lines where steep gradients occur. From what he has seen in St. Louis of the cable system, he states that on the largest cable roads there the effective force of traction is only 15 to 20 per cent of the power of the engine, while the troubles and interruptions have been numerous and serious. It is the storage car in his opinion that is destined to supply the necessities of all our large street railways, except those of very heavy grades and the chief recommendation, he says, is the fact that each storage car is an independent unit. "The importance of this, particularly in large cities and with long lines, cannot be over-estimated and I would recommend the electric motor, with storage batteries, even if a cable road could be constructed and operated at less expense."

The Fourth and Madison Avenue surface road of New York City gives indications that electric motors will take the place of horses.

The Julian Electric Company are now at work upon the plans that are intended to banish horses and confine steam to the work of turning a dynamo. An exhibition car has been going over the road at intervals during the past year, and it is now only a question of time when there will be a full line of electric motors on the road. It is proper to state that this surface road is the best equipped and most popular road in New York City.

The new dynamite cruiser gunboat called the *Yorktown*, designed for the United States Navy, is completed, and was launched 28th April. It carries four pneumatic guns for the hurling of dynamite projectiles, each with a range of at least a mile. The training of the guns is accomplished by steering the vessel, and the loading is all done by steam. The guns are 15-inch calibre, and the shells, which can be fired with great accuracy twice a minute, will contain 600lbs. of explosive gelatine, equivalent to 852lbs. of dynamite or 943lbs. gun-cotton. It is claimed that this gun, properly handled, will be the most destructive engine of war yet invented, for the heaviest armoured ships in the world will go all to pieces from the explosion of a shell much smaller than those thrown by the guns on the *Yorktown*. These guns are designed primarily to work on the underportion of the hulls of vessels, but if any inaccuracy in aim should be developed on account of the pitching of the ship, great damage can be inflicted upon the portion of the hull above water.

The use of paper fabric for building purposes is now advocated by some builders in this country. The term paper being meant a flexible sheet made of vegetable or other fibre which has been reduced to a pulp and then pressed out and spread and dried. Some of the grounds for advocating the use of the fabric are among the first continuity of surface; it can be made in rolls of any width and length; it is flexible and by gluing several layers together it may be made stiff and will stop the passages of the air because there are no joints. It has no grain like wood and will not split. It is not affected by temperature and thus has an advantage over sheet metal for roofing material. In its natural condition it is affected by moisture and may be rendered waterproof by saturating with asphalt or other like methods, and so on for other reasons, the combination of paper with other substances and solidifying the mass by pressure renders practicable the production of a material capable of replacing wood for many purposes.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Hyderabad, June 1, 1888.

Hyderabad Public Works Department Notification dated 7th February 1888, granting an extension of furlough to Europe on medical certificate for six months to Mr. M. J. Scobie, Executive Engineer, 3rd grade, sub. *pro tem.*, attached to the South Berar Division, is cancelled.

Consequent on Mr. R. W. Swinnerton, Executive Engineer, 4th grade, sub. *pro tem.*, proceeding on three months' privilege leave, Mr. A. A. Leventhorpe, Executive Engineer, 4th grade, temporary, assumed charge of the East Berar Division on the afternoon of the 15th instant.

Burma, June 2, 1888.

Upper Burma.

Mr. C. A. B. Target, Executive Engineer, 1st grade, is granted one month's privilege leave, with effect from the date on which he makes over charge of the Kyaukse Division.

With reference to *Burma Gazette* Upper Burma Notification dated the 23rd May 1888, Mr. W. G. Newton, Executive Engineer, 3rd grade, Mandalay Division, is placed in charge of the Kyaukse Division, in addition to his own duties, until further orders.

Lower Burma.

Mr. T. E. Owen, Executive Engineer, 1st grade, Toungoo-Mandalay Extension, Burma State Railway, is granted three months' privilege leave from the afternoon of the 2nd May 1888. This cancels Notification dated the 16th May 1888.

Mysore, June 2, 1888.

Mr. F. J. McLaughlin, Executive Engineer, took over charge of the Ashtagram Channel Division from Mr. A. Govindachariu, on the forenoon of the 26th ultimo.

Mr. C. B. Halagaiya Gauda, Assistant Engineer, Tumker Division, was granted privilege leave for 20 days, with effect from the 25th ultimo, or date of departure.

Madras, June 5, 1888.

The services of Colonel J. Beatty, R.E., are replaced at the disposal of the Military Department with effect from the 8th June 1888.

Special Examination leave for three months, from date of availing, is granted to Captain L. Langley, R.E., Executive Engineer, 2nd grade, sub. *pro tem.*

The following posting is ordered.

Mr. J. W. H. Ellis, Assistant Engineer, 1st grade, Honorary rank, to the VI Circle.

Bombay, June 7, 1888.

With the concurrence of the Government of India, His Excellency the Governor in Council is pleased to appoint Major W. Osborn, R.E., to be Executive Engineer, Aden, in succession to Colonel Cruickshank, R.E., appointed to act as Superintending Engineer, Southern Division, with effect from 1st May 1888. Major Osborn having taken charge of the duties of the appointment on the afternoon of the 30th April 1888.

Punjab, June 7, 1888.

Irrigation Branch.

Mr. J. J. Hatten, Executive Engineer, 3rd grade, from the 1st Division, Bari Doab Canal, which he left on the forenoon of the 5th May 1888, to the Chenab Canal Division, which he joined on the afternoon of the same date.

Mr. Hatten took over Executive charge of the Chenab Canal Division on the forenoon of the 9th May 1888, from Mr. J. J. Mullaly, Executive Engineer, who remains attached to the Chenab Canal Division on special duty.

Mr. J. H. Brooke, Executive Engineer, 4th grade temporary rank, from the Chenab Canal Division, which he left on the forenoon of the 5th May 1888, to the 2nd Division, Bari Doab Canal which he joined on the forenoon of the 8th idem.

Central Provinces, June 9, 1888.

Mr. R. B. Thomson, Executive Engineer, 2nd grade, attached to the Jubbulpore Division, is granted two months' privilege leave, from such date as he may be permitted to avail himself of it.

Mr. C. O. Leefe, Executive Engineer, 4th grade, attached to the Nagpur Division, is transferred to the Jubbulpore Division.

Three months' privilege leave, under Section 138 of the Civil Leave Code, is granted to Rao Sahib T. N. Mukhopadhyaya, Assistant Engineer, attached to the Eastern Division, with effect from the forenoon of the 28th ultimo.

N.-W. P. and Oudh, June 9, 1888.

Irrigation Branch.

Mr. A. C. Evans, Executive Engineer, 3rd grade, sub. *pro tem.*, Etawah Division, Lower Ganges Canal, is appointed to the charge of the Mainpuri Division, Lower Ganges Canal, during the absence of Mr. C. Perrin, Executive Engineer, on privilege leave, or until further orders.

With the approval of the Government of India, Mr. A. Grant, Executive Engineer, 1st grade, and Personal Assistant to the Chief Engineer, Irrigation Branch, is appointed, in addition to his

other duties, Under-Secretary to Government, North-Western Provinces, in the Public Works Department, Irrigation Branch.

Buildings and Roads Branch.

Rae Ram Kishen Mukerji, Sahib, Executive Engineer 4th grade sub. *pro tem.*, District Engineer, Bahraich, is granted leave on medical certificate for one year.

Babu Ghamandi Lal, Supervisor, 2nd grade, temporary rank, is appointed District Engineer, Bahraich, *vice* Rae Ram Kishen Mukerji, Sahib, granted leave on medical certificate, or until further orders.

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner, Oudh, is pleased to order the following promotions, with effect from the dates specified :—

Mr. C. H. Holme, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank from 14th April 1888, *vice* Mr. A. C. Crampton, Executive Engineer, on furlough.

Rae Dharni Dhar Banerji, Sahib, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank from 7th May 1888, *vice* Mr. J. W. Alexander, promoted to Superintending Engineer.

With the approval of the Government of India, Mr. J. H. P. Forsyth, Executive Engineer, 4th grade, and Officiating Personal Assistant to the Chief Engineer, Buildings and Roads Branch, is appointed, in addition to his other duties, Officiating Under-Secretary to Government, North-Western Provinces, in the Public Works Department, Buildings and Roads Branch.

Mr. W. C. Hennessey, Temporary Engineer, Allahabad, is transferred in the same capacity to the Bara Banki district as Temporary District Engineer.

India, June 9, 1888.

Mr. W. B. Taylor, Executive Engineer, 1st grade, State Railways, is granted special leave for one year and nine months under the terms of Public Works Department Notifications dated 3rd October, 1887. This cancels Public Works Department Notification, dated 17th May, 1888.

The Governor-General in Council is pleased to order the following promotions of Chief and Superintending Engineers, with effect from the dates specified :—

Lieutenant-Colonel C. W. I. Harrison, R.E., from Superintending Engineer, 1st class, sub *pro tem.*, to Superintending Engineer, 1st class, permanent with effect from 5th February 1888.

Mr. H. F. Storey, from Superintending Engineer, 2nd class, sub *pro tem.*, to Superintending Engineer, 2nd class, permanent with effect from 5th February 1888.

Major T. Gracey, R.E., from Superintending Engineer, 3rd class, sub *pro tem.*, to Superintending Engineer, 3rd class, special, with effect from 5th February 1888.

Mr. J. R. Bell, from Superintending Engineer, 3rd class, temporary rank, to Superintending Engineer, 3rd class, sub *pro tem.*, with effect from 5th February 1888.

Colonel J. G. Lindsay, R.E., from Chief Engineer, 3rd class, to Chief Engineer, 2nd class, permanent with effect from 13th April 1888.

Colonel A. LeMessurier, C.I.E., R.E., from Chief Engineer, 3rd class, sub *pro tem.*, to Chief Engineer, 2nd class, sub *pro tem.* with effect from 13th April 1888.

Colonel J. P. Steel, R.E., from Chief Engineer, 3rd class, temporary rank, to Chief Engineer, 3rd class, special with effect from 13th April 1888.

Colonel E. Swetenham, s.c., from Superintending Engineer, 1st class, sub *pro tem.*, to Superintending Engineer, 1st class, permanent, with effect from 13th April 1888.

Mr. F. J. Johnstone, from Superintending Engineer, 1st class, temporary rank to Superintending Engineer, 1st class, sub *pro tem.*, with effect from 13th April 1888.

Lieutenant-Colonel G. T. Skipwith, R.E., from Superintending Engineer, 2nd class, sub *pro tem.*, to Superintending Engineer, 2nd class, permanent, with effect from 13th April 1888.

Colonel A. LeMessurier, C.I.E., R.E., from Chief Engineer, 2nd class, sub *pro tem.*, to Chief Engineer, 2nd class, permanent, with effect from 26th May 1888.

Colonel C. J. Smith, R.E., from Chief Engineer, 3rd class, to Chief Engineer, 2nd class, sub *pro tem.*, with effect from 26th May 1888.

Lieutenant-Colonel W. G. Cumming, R.E., from Superintending Engineer, 2nd class, temporary rank, to Chief Engineer, 3rd class, special, with effect from 26th May 1888.

Mr. F. J. Johnstone, from Superintending Engineer, 1st class, sub *pro tem.*, to Superintending Engineer, 1st class, permanent, with effect from 26th May 1888.

Major F. Firebrace, R.E., from Superintending Engineer, 1st class, temporary rank, to Superintending Engineer, 1st class, sub *pro tem.*, with effect from 26th May 1888.

Major W. P. Tomkins, R.E., Superintending Engineer, 2nd class sub *pro tem.*, to Superintending Engineer, 2nd class, permanent with effect from 26th May 1888.

Mr. H. F. White, from Executive Engineer, 1st grade, and Superintending Engineer, 2nd class, temporary rank, to Superintending Engineer, 3rd class, permanent, and Superintending Engineer, 2nd class, sub *pro tem.*, with effect from 26th May 1888.

Mr. H. Joll, Executive Engineer, 1st grade, Bengal, is promoted to Superintending Engineer, 3rd Class, temporary rank, with effect from the 2nd June, 1888.

The Governor-General in Council is pleased to order the following promotions and reversions of Executive and Assistant Engineers attached to State Railways, with effect from the dates specified.

Captain W. V. Constable, R.E., from Executive Engineer, 3rd grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, permanent, with effect from 10th June 1887.

Mr. F. Wolley-Dod, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, sub. *pro tem.* with effect from 10th June 1887.

Mr. W. McHutchin, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, permanent, with effect from 10th June 1887.

Mr. G. F. Thompson, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, permanent, with effect from 10th June 1887.

Mr. W. Michell, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 9th July 1887.

Mr. W. Monies, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, sub. *pro tem.* with effect from 9th July 1887.

Captain B. Scott, C.I.E., R.E., from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.* with effect from 1st August 1887.

Mr. H. J. Oddie, from Executive Engineer 4th grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, sub. *pro tem.* with effect from 1st August 1887.

Mr. S. De Brath, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.* with effect from 1st August 1887.

Mr. W. E. Newham, from Executive Engineer, 4th grade temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.* with effect from 4th August 1887.

Mr. R. W. Egerton, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary, with effect from 26th August 1887.

Captain B. Scott, C.I.E., R.E., from Executive Engineer, 2nd grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, with effect from 1st October.

Mr. H. J. Oddie, from Executive Engineer, 3rd grade, sub. *pro tem.*, to Executive Engineer, 4th grade, sub. *pro tem.* with effect from 1st October.

Mr. H. J. Oddie, from Executive Engineer, 4th Grade, sub *pro tem.*, to Executive Engineer, 3rd grade, sub *pro tem.* with effect from 8th October 1887.

Mr. E. E. A. Küster, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub *pro tem.* with effect from 8th October 1887.

Mr. G. Mills, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 13th October 1887.

Mr. H. B. Taylor, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 17th October 1887.

Captain B. Scott, C.I.E., R.E., from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub *pro tem.* with effect from 17th October 1887.

Mr. H. E. Haddon, from Executive Engineer, 4th grade, sub *pro tem.*, to Executive Engineer, 3rd grade, sub *pro tem.* with effect from 17th October 1887.

Mr. F. R. Tebbs, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, sub *pro tem.* with effect from 17th October 1887.

Mr. H. B. Taylor, from Assistant Engineer, 1st grade, to Engineer, 4th grade, temporary, with effect from 17th October 1887.

Mr. J. M. Montague, from Executive Engineer, 4th grade, sub *pro tem.*, to Executive Engineer, 3rd grade, sub *pro tem.* with effect from 20th October 1887.

Mr. G. P. Rose, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, sub *pro tem.* with effect from 20th October 1887.

Mr. H. B. Taylor, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 21st October 1887.

Mr. J. C. Mills, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 29th October 1887.

Mr. G. Deuchars, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 29th October 1888.

Mr. M. J. Chabrel, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, permanent, with effect from 1st November 1888.

Mr. Labdha Rama Sahni, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, permanent, with effect from 1st November 1888.

Mr. H. McMillan, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, permanent with effect from 1st November 1887.

Mr. F. Wolley-Dod, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, permanent, with effect from 10th November 1888.

Mr. J. N. D. LaTouche, from Executive Engineer, 4th grade,

temporary rank, to Assistant Engineer, 1st grade, with effect from 22nd November 1888.

Mr. R. C. Dyson, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 25th November 1888.

Mr. E. T. Faulkner, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 26th November 1888.

Mr. W. R. Shaw, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 1st December 1888.

Mr. J. Manson, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 7th December 1888.

Mr. E. J. Alexander, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 10th December 1888.

Mr. J. F. H. Collet, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 12th December 1888.

Mr. C. E. C. Montresor, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 17th December 1888.

Mr. R. A. Way, from Executive Engineer, 2nd grade, sub. *pro tem.* to Executive Engineer, 2nd grade permanent, with effect from 17th December 1888.

Mr. F. R. Bagley, from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.* with effect from 17th December 1888.

Mr. H. S. Harington, from Executive Engineer, 3rd grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, permanent, with effect from 17th December 1888.

Mr. E. Baker, from Executive Engineer 4th grade sub. *pro tem.* to Executive Engineer 3rd grade, sub. *pro tem.* with effect from 17th December 1888.

Mr. C. E. C. Montresor, from Assistant Engineer, 1st grade to Executive Engineer, 4th grade, temporary rank, with effect from 17th December 1888.

Mr. C. E. C. Montresor, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer 1st grade, with effect from 28th December 1887.

Mr. R. W. Roberts from Assistant Engineer, 1st grade to Executive Engineer, 4th grade, permanent, with effect from 1st January 1888.

Honble E. H. S. Napier, from Assistant Engineer, 2nd grade to Assistant Engineer, 1st grade, permanent, with effect from 1st January 1888.

Mr. J. M. Harman, from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.* with effect from 1st January 1888.

Mr. F. Lang, from Executive Engineer, 4th grade, sub. *pro tem.* to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 1st January 1888.

Mr. G. A. Savielle, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 1st January 1888.

Mr. C. E. C. Montresor, from Assistant Engineer 1st grade, to Executive Engineer, 4th grade, temporary, with effect from 1st January 1888.

Mr. G. Humfress, from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 1st January 1888.

Mr. C. J. S. Baker, from Executive Engineer, 4th grade sub. *pro tem.*, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 1st January 1888.

Mr. R. T. Denne from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 1st January 1888.

Mr. J. F. H. Collet, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 1st January 1888.

Mr. T. Ker, from Executive Engineer, 3rd grade, to Executive Engineer 2nd grade, sub. *pro tem.*, with effect from 1st January 1888.

Mr. J. E. Dallas, from Executive Engineer, 4th grade, sub. *pro tem.* to Executive Engineer 3rd grade, sub. *pro tem.*, with effect from 1st January 1888.

Mr. W. Home, Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, sub. *pro tem.* with effect from 1st January 1888.

Mr. R. C. Dyson, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 1st January 1888.

Mr. R. Sivewright, from Executive Engineer, 4th grade, sub. *pro tem.* to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 1st January,

Mr. V. E. DeBroe, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.* with effect from 1st January, 1888.

Mr. E. J. Alexander, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary, rank with effect from 1st January, 1888.

Mr. R. S. J. Routh, from Executive Engineer, 4th grade, sub. *pro tem.* to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 1st January 1888.

Mr. J. E. Gabbett, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 1st January 1888.

Mr. W. R. Shaw, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 1st January 1888.

Mr. H. S. Talbot, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 1st January 1888.

Mr. W. A. Johns, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 1st January, 1888.

Mr. E. H. Tuck, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 4th January, 1888.

Mr. H. W. Warden, from Executive Engineer, 2nd grade, to Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 6th January, 1888.

Mr. P. Duncan, from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 6th January 1888.

Mr. W. S. Haig, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 6th January 1888.

Mr. Babu Mal, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade sub. *pro tem.*, with effect from 6th January 1888.

Mr. H. S. Guinness, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 6th January, 1888.

Captain G. F. Wilson, R.E., from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.* with effect from 6th January, 1888.

Mr. R. W. L. Tooze, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 6th January 1888.

Mr. R. J. Woods, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 6th January, 1888.

Mr. J. C. Mills, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary with effect from 6th January 1888.

Mr. C. S. Rennick from Assistant Engineer, 1st grade, to Executive Engineer 4th grade, temporary with effect from 7th January, 1888.

Mr. H. B. Taylor, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary with effect from 11th January, 1888.

Mr. H. G. F. Smith, from Executive Engineer, 4th grade, sub. *pro tem.* to Executive Engineer, 3rd grade, sub. *pro tem.* with effect from 27th January, 1888.

Mr. W. Chadwick, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer 4th grade, sub. *pro tem.* with effect from 27th January 1888.

Mr. G. Deuchars, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 27th January 1888.

Mr. H. W. Warden, from Executive Engineer, 1st grade, sub. *pro tem.* to Executive Engineer, 2nd grade, with effect from 1st February 1888.

Captain G. F. Wilson, R.E., from Executive Engineer, 2nd grade, sub. *pro tem.* to Executive Engineer 3rd grade, with effect from 1st February 1888.

Mr. H. G. F. Smith, from Executive Engineer 3rd grade, sub. *pro tem.* to Executive Engineer 4th grade, sub. *pro tem.* with effect from 1st February 1888.

Mr. W. Chadwick, from Executive Engineer, 4th grade, sub. *pro tem.* to Executive Engineer 4th grade, temporary rank with effect from 1st February 1888.

Mr. G. Deuchars, from Executive Engineer 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 1st February 1888.

Mr. W. H. Cole, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, permanent, with effect from 4th February 1888.

Lieutenant O. M. R., Thackwell, R.E., from Assistant Engineer, 1st grade, sub. *pro tem.*, to Assistant Engineer, 1st grade, permanent with effect from 4th February 1888.

Mr. W. Chadwick, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 4th February 1888.

Mr. G. Deuchars, from Assistant Engineer 1st grade, to Executive Engineer 4th grade temporary rank, with effect from 4th February 1888.

Mr. G. Deuchars, from Executive Engineer 4th grade, temporary rank, to Assistant Engineer, 1st grade with effect from 11th February 1888.

Mr. C. F. Sykes, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, permanent, with effect from 17th February 1888.

Mr. P. Duncan, from Executive Engineer, 2nd grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, with effect from 17th February 1888.

Mr. H. G. F. Smith, from Executive Engineer, 4th grade, sub.

pro tem., to Executive Engineer, 3rd grade, *sub pro tem.*, with effect from 17th February 1888.

Mr. L. G. Prickett from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, *sub pro tem.*, with effect from 17th February 1888.

Public Works Notification dated 6th January, 1888, is hereby cancelled.

Mr. T. H. Wickes, Superintending Engineer, 2nd Class, Bengal, is temporarily transferred to North-Western Provinces and Oudh, and appointed to officiate as Chief Engineer and Joint Secretary to that Government, with the rank of temporary Chief Engineer, 3rd class.

Major A. D. McArthur, R.E., Executive Engineer, 1st grade, Bengal, is temporarily promoted to Superintending Engineer, 3rd class, *vice* Mr. Wickes, temporarily transferred to the North-Western Provinces and Oudh.

Mr. H. F. Storey, Superintending Engineer, Class II., State Railways, is transferred from the Establishment under the Government of Bengal to Hyderabad, and appointed Officiating Superintending Engineer and Secretary to the Resident in the Public Works Department.

The services of Mr. J. Willcocks, Assistant Engineer, 1st grade State Railways, are temporarily placed at the disposal of the Government of Bombay.

North-Western Railway.

Mr. J. Adams, Assistant Engineer, 2nd grade, passed the colloquial examination in Hindustani, on the 24th March 1888.

Assam, June 9, 1888.

Privilege leave for three months, is granted to Mr. W. McM. Sweet, Executive Engineer, 4th grade, temporary rank, and District Engineer, Sibsagar, with effect from 7th July 1888, or from such subsequent date as he may avail himself of it.

Mr. E. J. Mitchell, Assistant Engineer, 1st grade, who was appointed to officiate as District Engineer, Kamrup, in Orders dated 16th May 1888, reported his arrival at Gauhati on the afternoon of the 31st May 1888, and took over charge of the Office of the Public Works Department, Kamrup, from Mr. A. C. Campbell, Deputy Commissioner in charge of Public Works, Kamrup, on the afternoon of the 1st June 1888.

Mr. W. E. Knight, Apprentice Engineer, who was temporarily transferred to the Khasi and Jaintia Hills Division, in Orders dated 31st May 1888, reported his arrival at Shillong on the afternoon of the 3rd June 1888.

Mr. D. J. Clancy, Assistant Engineer, 1st grade, and Officiating District Engineer, Cachar, is transferred to the Sibsagar district, and appointed to officiate as District Engineer of that district and Manager of the Jorhat State Railway, *vice* Mr. W. McM. Sweet, proceeding on privilege leave.

Matadin Sukul, Rai Sahib, M.A., Assistant Engineer, 3rd grade, and Officiating District Engineer, Sylhet, is transferred to the Cachar district and appointed to officiate as District Engineer of that district on the return from privilege leave of Rai Preonath Banerjee, Bahadur, Executive Engineer.

Bengal, June 13, 1888.

Establishment—General.

Mr. J. H. Toogood, Executive Engineer, is granted privilege leave for three months, with effect from the 4th July 1888, or from such subsequent date as he may avail himself of it.

Mr. B. K. Finimore, Executive Engineer, in charge of the Jessore Division, is posted to the Second Calcutta Division, during the absence, on leave, of Mr. Toogood, or until further orders.

With reference to Government of India, Public Works Department Notification dated 6th instant, Mr. H. Joll is appointed to officiate as Superintending Engineer of the Western Circle.

Establishment—Irrigation.

Mr. A. S. Thomson, Assistant Engineer, has been granted by Her Majesty's Secretary of State for India an extension of four months' furlough.

Mr. C. H. DeMello, Assistant Engineer, has been granted by Her Majesty's Secretary of State for India one month's extraordinary leave, without pay, in extension of previous leave granted.

With reference to Government of India, Public Works Department Notification dated the 7th instant, Major A. D. McArthur, R.E., is appointed to officiate as Superintending Engineer of the South-Western Circle.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 4th June, 1888.

119 of '87.—Patrick Daley, Engine Driver, Rajputana-Malwah, Railway, residing at Sabarmati, near Ahmedabad, Guzerat.—*For improved danger signals, the mode or manner of working them on Railway trains and apparatus therefor, also hand signals for shunting and other purposes.*

214 of '87.—Samuel Cleland Davidson, of Sirocco Works, Belfast, Antrim, Ireland, Merchant.—*For improvements in apparatus for employing heated air in drying or baking vegetable or other substances.*

232 of '87.—Stuart Caradoc Munro, of London, in the County of Middlesex, England, Gentleman.—*For improved method of and apparatus for preventing the fraudulent opening of safes.*

249 of '87.—Thomas Freeman Nott Finch, of Sidbury Works, Worcester, in the County of Worcester, England, Button Manufacturer.—*For improvements in the construction of the axles and axle-boxes for the wheels of common road carriages, and in the method of and means and appliances for lubricating the same.*

55 of '88.—Homer Taylor Yaryan, Manufacturer, residing in the City of Toledo, in the County of Lucas, State of Ohio, one of the United States of America.—*For vacuum evaporating and distilling apparatus.*

66 of '88.—Gaston Ragot, of 117 Boulevard Anspach, Brussels, in the Kingdom of Belgium, Engineer.—*For apparatus for supplying combustible fluid to oil or gas motor engines.*

75 of '88.—Howard Matravers Ashley, of Ferrybridge, Yorkshire, England, Machinist.—*For improvements in the manufacture of bottles and other articles in glass.*

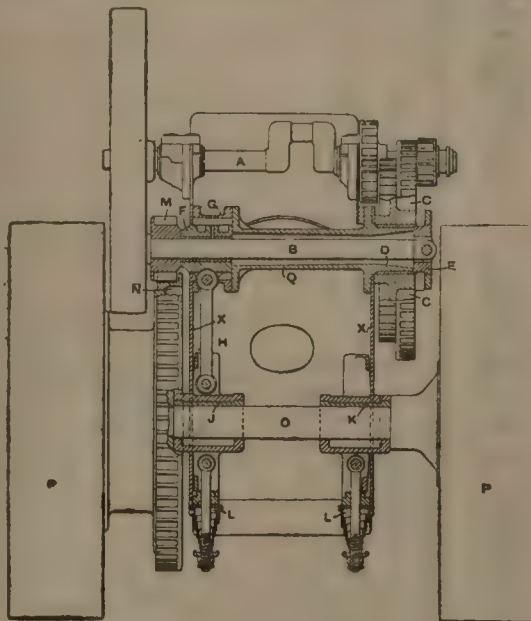
76 of '88.—Howard Matravers Ashley, of Ferrybridge, Yorkshire, England, Machinist.—*For improvements in the manufacture of bottles and other hollow-ware in glass and in the machinery for the same.*

79 of '88.—Rudolf Sjöberg, of Stockholm, in the Kingdom of Sweden, Engineer.—*For a new or improved explosive.*

81 of '88.—Ivar Axel Ferdinand Bang, of Rue de la Passy, Paris, France, Chemist, and Marie Charles Alfred Ruffin, of Avenue d'Antin, Paris, France, Chemist.—*For a process and apparatus for purifying crude spirit and regenerating the purifying agent.*

RECENT BRITISH PATENTS.

TRACTION ENGINES.—*F. J. Burrell, Thetford, Norfolk.*—The annexed diagram represents a transverse section of a traction engine embodying the present improvements. The crank shaft A transmits motion to the counter shaft B by means of pinions gearing with the spur wheel



C. This spur wheel revolves on the fixed tube D, and is connected to the counter shaft B by a universal joint. The other end of B is carried in a bearing F, which is free to move up and down in the box G. The link H connects F to the axle box J, which is free to slide up and down in the guides S secured to the horn plates X. A pinion M is fixed to the counter shaft, and gears with the wheel N, thus communicating motion to the road wheels P. The wheels M and N are prevented from altering the distance between their centres by the link H, and there is sufficient clearance at the sides of the teeth to allow for the sideways motion of the engine on its springs. An extension Q to the tube D is carried across the engine, and is bolted to the box G, thus forming a solid bearing for the spur wheel C, and a stay between the horn plates X. The inventor makes two claims: (1) For engine mounted on springs and having the counter shaft over the main axle; (2) for coupling one of the main axle bearings to the counter shaft, and connecting the opposite end of the counter shaft by a flexible coupling to a spur wheel mounted loosely on the fixed tube for the purpose described.—No. 5747. 20th. April 1887.

Advertisements.

WANTED a Draftsman, who also possesses a thorough knowledge of estimating, for the Office of the Executive Engineer, Pooree Division at Cuttack. Salary Rs. 45 per mensem rising to Rs. 50.

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CHITTAGONG;
The 1st June 1888.

F. SILLS, C. E.,
EXECUTIVE ENGINEER,
Chittagong Division.

(138)

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(140)

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c/o EDITOR

Of this Journal.

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Applications, with copies of testimonials, will be received up to 15th June 1888.

KHETTRO NATH BANERJEE,

Offg. District Engineer,

MYMENSINGH.

MYMENSINGH
DISTRICT ENGINEER'S OFFICE,
The 2nd June 1888.

NOTICE.

WANTED an Overseer for the District Board, Midnapore, on a salary of Rs. 60 and Travelling Allowance Rs. 25 per mensem. Candidates must be qualified according to the Rules laid down in the Calcutta Gazette, part IX., page 79, dated 14th March 1887.

Applications will be received by the undersigned up to the 15th June 1888.

C. VOWELL,

Chairman, District Board,

MIDNAPORE.

(136)

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Extracts from the Twenty-sixth Annual Report viz. for the year 1887.

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District Board Office, } President.
18th May 1888. } (129)

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[29]

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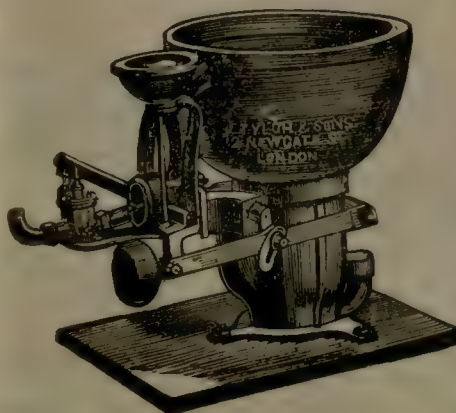
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Lahore Division,

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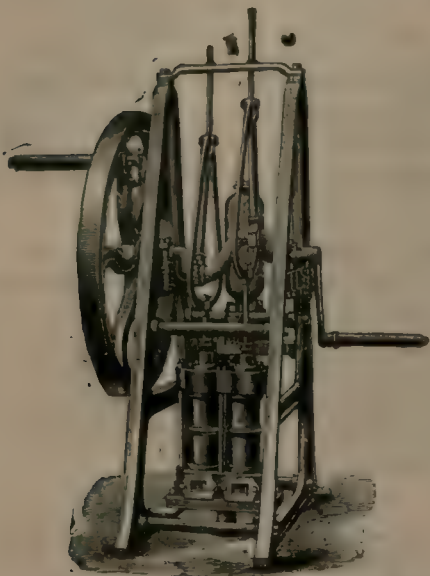
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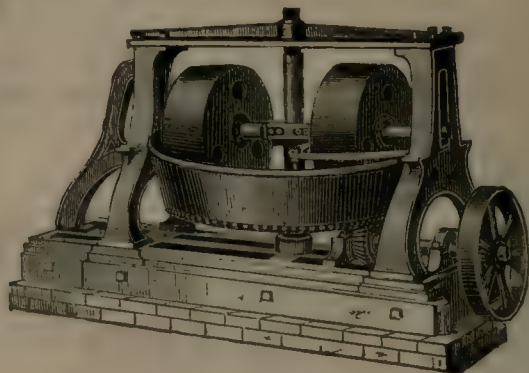
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"Artesian Borings in the Sunderbunds."

As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

Price Rs. 2 per copy.—Cash.

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INDIAN ENGINEERING.

SATURDAY, JUNE 23, 1888.

FAILURE OF THE KALI NADI AQUEDUCT.

SOME weeks ago we acknowledged the receipt of a selection of papers from the records of the Government of India regarding the failure of the Kali Nadi Aqueduct on the Lower Ganges Canal. We have read the various reports with much interest, and we propose now to state briefly the causes which led to the accident.

The catchment basin drained by the Kali Nadi where it is crossed by the Lower Ganges Canal at Nadrai, is 2,377 square miles. The length of the basin is five times its breadth, the soil is very sandy, and the country flat.

To enable our readers to understand fully the assumption made by the Superintending Engineer when submitting the project in 1871, we cannot do better than quote extracts from his report. "No actual measurements have been taken of the flood discharge of this river. We have been obliged to depend solely on the theoretical volume deduced from calculations based on the longitudinal and cross sections of the Nadi * * when the area of the catchment basin is very large, as in the present case. No satisfactory results can be obtained from meteorological statistics. Allowing 6 inches to be the greatest known rainfall in 24 hours, and assuming, that only $\frac{1}{4}$ inch of this is passed off in surface drainage, which according to Rankine is a small proportion, we find the river would discharge 38 cubic feet per second for every square mile of area drained. Whereas the highest flood, 26,384 cubic feet per second, this Nadi has ever been known to pass down, gives only 8.7 cubic feet per second per square mile."

The design submitted provided for a discharge of 36,300 cubic feet per second. To pass this discharge a velocity of 10 feet per second was assumed, but owing to the sandy nature of the soil, the Chief Engineer did not consider it advisable to adopt so high a velocity. He therefore returned the scheme, and suggested that the velocity should be reduced one half by increasing the waterway.

In 1873 the Superintending Engineer, Major Jeffreys, resubmitted his design. It seems that a little below the proposed site of the Aqueduct there is a bridge over the Bareilly-Hathras Road, which is reported to have stood for more than a century. From a high flood mark on this bridge a calculation was made which placed the maximum flood discharge of the river somewhere between 9,000 and 10,000 cubic feet per second, equivalent to a discharge of 3.66 cubic feet per square mile, the catchment area assumed being 3,025 square miles. In his report Major Jeffreys says, "It would, I think, be safer to design our work on the rateable proportion of 7 cubic feet per second per square mile of area drained. This is a rate that is often used in dealing with long and large catchment basins, and with such a sandy soil as that mostly found in the Anoopshahr Doab, there

would not. I conceive, be any risk in employing it. With the Mogul bridge of more than a century old staring me in the face, I cannot recommend any greater provision than that made in the design now submitted, *viz.*, 5 spans 35' x 14', which give an effective waterway of 2,380 square feet, that of the Mogul bridge being only 1,146 square feet."

The design was sanctioned, but the Aqueduct was short-lived. On the 2nd October 1884 it was almost carried away by a flood, the estimated full discharge of which was probably not less than 44,000 cubic feet. Colonel Forbes, the Chief Engineer, in his report, pointed out that the proportion of 7 cubic feet per square mile was less than half of what ought to have been given, and that flood discharges of road bridges are utterly unreliable, as their approaches are invariably breached, and allow the flood water to escape round their flanks.

On the 17th July 1885 the Aqueduct was completely wrecked by an extraordinary high flood, whose estimated discharge could not have been under 130,000 cubic feet per second. This flood came at a most opportune time, or probably some years hence, the new Aqueduct, which would have been designed for a discharge of 18 cubic feet per square mile, would have shared the same fate as its predecessor. The new design now sanctioned provides for a flood discharge of 140,000 cubic feet with a velocity of 6 feet per second. The factor of discharge per square mile of catchment area is 58.8 cubic feet per second, and the effective waterway is equivalent to 9.81 square feet per mile drained.

The flood of the 2nd October 1884 was caused by a rainstorm travelling down the valley of the Nadi. On the 29th September 4.8 inches and 1.8 inches were registered above and below Bulandshahr, respectively. On the 30th September 6.4 inches and 6.3 inches.

The flood of July 1885 was due to a storm travelling across the catchment basin. Rainfall of 17.6 inches and 18.2 inches was registered at Bulandshahr and Gangaoli on the 16th. Bulandshahr is near the centre of the basin, while on the 15th, in the after part, two stations registered 5.7 inches and 3.2 inches, respectively.

We have now finished with the report, and although Engineers are well aware how difficult it is to base any reliable calculations of flood discharges on rainfall returns, still we think the lesson taught by the failure of the Nadrai Aqueduct is twofold:—

1st.—That it is quite possible for heavy rainfall to extend over a large tract of country.

2nd.—That in two consecutive years it is possible to have continuous rainfall ranging from 6 inches to 18 inches, even in a district the average rainfall of which is under 40 inches. According to Rankine 1½ inch of available rainfall per 24 hours gives a factor of 40 cubic feet per second per square mile, and with an assumed velocity of 5 feet the ventage required per square mile of catchment basin is 8 square feet. In the new Nadrai Aqueduct a ventage of 9.81 square feet has been provided. It would therefore seem to be advisable, when designing similar works in future, to stick to Rankine's rule, and leave a margin for safety.

THE P. W. D. AND THE FINANCE COMMITTEE.

IF the deliberations of the Finance Committee in reference to the P. W. D. are at all an indication of the general spirit of its work in the other departments of the administrative machinery, it will easily suggest itself to our readers, that the enquiry has been throughout a solemn farce, and public opinion has been completely ignored. But this is not all. The astounding ignorance of the constitution and requirements of the Department displayed by the Committee, together with the proportionate contempt for a knowledge of the true state of affairs, and a corresponding arrogance in assuming that it had grasped the difficulty and confined it within a nutshell, all go to prove what return the rate-payers have received for the investment of their funds in the upkeep of the empty show which the Finance Committee has proved! In officialdom, self-glorification is a virtue, and there is no section of the public service more saturated with it than the heaven-born class; but to the credit of one of its members—Sir T. Hope—be it said that he has torn the mask and shewn in its naked hideousness the pretensions of the Committee in dealing with such a subject.

In the Resolution of the Government of India in the Financial Department, constituting the Finance Committee the following passage occurs:—"It is not desired that the Committee should propose any material modifications in arrangements which have in recent years been carried out after mature deliberation under the sanction of the Secretary of State; but they will be expected to pursue a similar line of enquiry so far as regards departments or branches with which the changes effected in late years have not definitely dealt, or in which the reforms hitherto effected may prove to have failed to secure the economy aimed at."

To a man of ordinary intellect the meaning of the passage is obvious enough, and as Sir T. Hope puts it, it "was framed after full consideration in the Council, with the object of excluding from the Committee's enquiry questions of organic structure of the Civil Administration which had been recently dealt with, and, in particular, of the Engineer Establishment of the Public Works Department, which had been settled by the Secretary of State only fifteen months previously; after an elaborate correspondence extending over several years."

But the Committee by-and-bye exceeded its jurisdiction, and Sir T. Hope on receiving a 'Note' from one of their Sub-Committees expressed his objections to dealing with it for obvious reasons, and the matter remained in *statu quo*, the said 'Note' having been incorporated in the body of the Report to which he has given a crushing reply. It would be an invidious task to paint the lily or to gild refined gold; on the same principles we refrain from noticing the points raised by Sir T. Hope. He is no 'professional,' but the grasp he possesses of the questions at issue is far beyond what the Committee could ever accomplish; he has demolished the Committee's position with a completeness which leaves nothing to be

desired. Any attempt to refute his arguments will be tantamount to Mrs. Partington's attempt to stop the encroachments of the Atlantic with a mop. Let us therefore pass on to other subjects.

In the matter of local purchase of European stores the Report recommends that they should not be purchased in India, (of course with the usual stereotyped qualification "where possible,") but by making it easier and quicker than now to procure them through the Director-General of Stores, and in exceptional cases to authorize local purchases by providing an agency through which the best information as to price and quality can be obtained. If this suggestion is carried, it will toll the knell of Indian trade. While so much talk is going on about technical education and the promotion of indigeneous manufactures, so that India may remain as independent of England as possible, the Committee deliberately propose that, save and except in certain cases, goods should be procured from home, and through the Agency of the Director-General of Stores; in other words, to leave as much room for jobbery and corruption as may be possible under the circumstances. Why have such an Agency at all? Why not leave the matter to public competition, so that the State may be a gainer at the end, and be properly served too? As for making the purchase "easier and quicker," we have had some experience of the Circumlocution office in the P. W. D. and know how expeditiously it is worked in comparison with private contract. Then why provide a local "agency through which the best information as to price and quality can be obtained?" Every Indian exporting firm knows exactly what the requirements of the country are, and if they are only encouraged to manufacture here or procure goods from England, there would not be the slightest difficulty in securing anything required here. This would obviate a reference to the Director-General of Stores; in fact, the articles could be had at a moment's notice, instead of going through the form of indenting for them from England. Of course the former course would be wanting in one respect,—no portion of the price of the goods would stick in the palm of the middlemen, a consummation most devoutly to be wished.

The last paper in the Report puts forward a scheme for obviating what has hitherto been a great stumbling block in the way of extending the system of provincialism to new canals or other works, by providing that interest on the capital expended, shall not be levied from the Province which gives the guarantee, till such time as it may reasonably be expected that the work will become productive.

With regard to House rent and Presidency allowances, which certain classes of officers in Calcutta, Madras and Bombay are entitled to, they are somewhat modified, and rules are laid down as to the persons who shall be entitled to them, but there is an objection to permit these privileges in hill stations.

The Committee have proposed reductions in the Public Works Department in all its branches to the extent of Rs. 27,57,000, not including the local purchase of European stores and the Provincialization of Irrigation which have not been estimated.

AN ECONOMIC PROBLEM.

It is contended by Mr. Cursetjee Sorabjee Jussawalla of Bombay that the wealth of India mainly consists in its agriculture and he deprecates the use of steam power, or any other motive power save bullocks and buffaloes in farming operations. Therein we consider him decidedly on the wrong tack. Consensus of educated opinion now-a-days is altogether against him, and inclines strongly to faith in the uses, aptitudes, and economies that go with employment of machinery.

Year by year agriculturists all over the world are learning to depend less than they did on the chances and vicissitudes of animal life to get their work done, more and more on the equable, steady, untiring pulsations of the steam engine and its manifold adaptations to a farmer's needs.

That is to say that the world at large is progressing utilitarianly, not retrograding as our Parsee friend would desire it to. His argument is more pertinent when he quotes from the Imperial Gazetteer's article on "India." Thus:—

"The first impediment to better husbandry is the fewness and weakness of the cattle. Over a great portion of the Empire, writes the Secretary to the late Agricultural Department in India, the mass of the cattle are starved for six weeks every year. The hot winds roar, every green thing has disappeared, no hot weather forage is grown; the last year's fodder has generally been consumed in keeping the well bullocks on their legs during the irrigation of the spring crops; and all the husbandman can do is just to keep his poor brutes alive on the chopped leaves of the few trees and shrubs he has access to, the roots of grass and herbs that he digs out of the edges of fields, and the like. In good years, he just succeeds; in bad years, the weakly ones die of starvation. But then come the rains, and within the week, as though by magic, the burning sands are carpeted with rank luscious herbage, the cattle will eat and over-eat; and millions die of one form or other of cattle disease, springing out of this starvation followed by sudden repletion with rank, juicy immature herbage. He estimates the average annual loss of cattle in India by preventible disease at ten million beasts, worth seven and half millions sterling."

When compared with this melancholy, and "preventible" holocaust the sum total of cow killing in India for European use sinks to very insignificant proportions, and is—so to speak—but a drop in overwhelming flood.

The chief cause of the diminution in number and deterioration in breed of Indian cattle is India's excess of population. In bygone years, when sanitation was an unknown science, and fevers and epidemics were chronic, when Governments did not do anything to check the course of a famine, when wars were frequent, and the ravages of wild beasts still more so, this excess of population was prevented. The soil was not overcrowded. There were waste lands and common lands in plenty all over the country; pasturage abounded; cattle consequently flourished. They do not flourish

now because in almost all this village pasturage has, under stress of hard times, been brought under cultivation, and because pressure of population has impoverished the ryot, and he is unable to afford his cattle a due supply of food.

Probably the only means by which verily and indeed the breed of Indian cattle could be restored to its pristine excellence and abundance would be the imposition of legal restrictions on child marriages amongst Hindoos. A check that is to say on over population, on the consequent poverty of our ryots, and their consequent inability to maintain their oxen. This may seem, at first sight, a too sweeping contention, a paradox even. We feel sure, however, that the more it is looked into and studied the more apparent its truth will be. Granted—says some candour-loving soul—but the idea is preposterous: such interference with quasi-religious prejudices, such encroachment on the liberty of the subject would out-Herod Herod; could not be tolerated for a day even. We are quite prepared to admit it. Nevertheless, it is also true that no other remedy will avail unless we put back the clock, and revert to insanitation and insecurity of life and property by way of economical prevention to overcrowding on the soil. Such reversion to a dead-and-gone disorder of affairs is manifestly out of the question under British rule. We must make the best of circumstances as they are.

A competent Agricultural Bureau might do much towards resuscitating cattle stock. It might improve the breed of sheep and goats. It might discover how to utilize silos, and “invent” some new and cheap fodder supply. With scientific, skilled and trained men conducting its operations their sphere of usefulness, of efficient help to Indian agriculturists would be practically boundless. Meanwhile, there is stagnation in matters agricultural, and in default of sensible suggestions propositions like that of Mr. Jussawalla find acceptance, and speciously appeal to vulgar prejudice.

Much might be done to modify existent agricultural conditions, and remedy depression by the introduction of cheap, serviceable, wear and tear standing, Western-world-approved agricultural machinery. But if it is intended that such machinery should commend itself to bucolic approval, it must, above all things, be cheap, within purse-string reach of the hand-to-mouth living mortals for whose behoof it professes to be intentioned. Expensive ploughs, harrows, drills, and so forth are worse than useless; serve only to disgust the purchaser, who complains firstly as to their cost, secondly that his cattle have not the strength needful to put them to any practical use. A cheap, light, practicable Indian plough is a discovery yet open to Indian inventors. Let it be remembered always that in most Indian soils deep ploughing is not desirable, is often the very reverse of desirable. If this, and other local considerations are kept in mind, there should be no great difficulty in the procurement of suitable implements; and as we have already said substitution of machinery for animal labor could do much to relieve the strain.

Notes and Comments.

RANGOON MUNICIPAL P. W. BUDGET.—The expenditure on Public Works this year will be Rs. 3,09,800.

BAD NEWS.—It is denied that Sir Charles Elliot will be the first Lieutenant-Governor of British Burma.

COLONEL STEEL'S SUCCESSOR IN THE C. P.—Mr. J. G. H. Glass succeeds Colonel Steel as Chief Engineer and Secretary to the Chief Commissioner of the Central Provinces in the Public Works Department.

THE NEW MUNICIPAL BUILDING, BOMBAY.—The Bombay Corporation has decided to employ Mr. F. W. Stevens to design and carry out the building of the new Municipal Offices, not restricting him as to cost or style.

MADRAS MUNICIPAL PUBLIC WORKS.—Of the total expenditure of Rs. 11,26,404 in 1886-87, against Rs. 11,43,970, anticipated in the revised estimate, and Rs. 11,43,253, incurred in 1885-86, Public Works absorbed Rs. 4,30,251 or 38.2 per cent.

PENNER BRIDGE, MADRAS RAILWAY.—The Government of India have sanctioned the revised estimate, amounting to Rs. 9,92,716, chargeable in the proportion of Rs. 7,37,640 to Capital, and Rs. 2,55,076 to Revenue, of the cost of reconstructing the Penner Bridge on the Madras Railway.

TANSA WATER-WORKS.—Somebody suggests in a Bombay paper that the Municipality extend the term of agreement of Messrs. Walsh Lovett Mitchell and Co., as it would be simply putting the cart before the horse to push on the work of these contractors before that undertaken by Messrs. Glover and Co. is completed.

WHAT DOES IT MEAN?—Mr. G. H. Simmons is appointed to be a Commissioner for making improvements in the Port of Calcutta, with effect from the 11th May 1887, *vice* Mr. W. Duff Bruce, whose term of office as a Port Commissioner has expired. Mr. Simmons is also appointed to be Vice-Chairman of the Port Commissioners, Calcutta.

MADRAS HARBOUR TRUST AND MR. THOROWGOOD'S SUCCESSOR.—The Harbour Trust have appointed Mr. Lee Pogson Engineer of the Harbour Works, *vice* Mr. Thorowgood resigned. An application by the latter for a gratuity was refused. Mr. Pogson has been hitherto Assistant Engineer. His salary will be Rs. 850 a month rising by annual increments of Rs. 50 to Rs. 1,000.

SEEBPORE ENGINEERING COLLEGE.—The Report of the “Re-organization” Committee is ready, but publicity is withheld pending the receipt of the signatures of two members now absent from India.—We glean that some sort of a mess has been made in assessing the “drawings” at the recent University Engineering Examinations, by the perpetration of an inexcusable muddle.

THE BENGAL-NAGPUR RAILWAY.—The work between Rangunathpur and Purulia has been pushed on with such energy that the line is expected to be available for traffic early in 1889. The bridge over the Damuda is a difficulty which may delay the opening of the Asansol Section till the early part of 1890, when the Chakardarpore tunnel will probably have been completed.

RANGOON DRAINAGE WORKS.—The question of financing this scheme resolves itself into this:—The Municipality has entered into a contract for works costing £187,000, which was estimated at Rs. 23,00,00. From causes beyond their control the works will cost Rs. 28,00,000 and only Rs. 21,00,000 are available, therefore seven lakhs have to be borrowed and provision made for the interest on that sum,

ADVANCE RANGOON!—The Manager of the Irrawaddy Flotilla Company, Limited, Rangoon, offered to light the Phayre Street wharf by electricity every night when necessary, for a period not exceeding 12 months, at the rate of Rs. 500 per mensem, the Company supplying all the necessary plant and fittings and guaranteeing to keep it working in an efficient manner. The Port Trust have resolved to accept the offer.

PROPOSED NEW RAILWAY.—A project for constructing a line of rail from Bangalore to Guntakul is now, it is said, receiving attention. The line is to be broad gauge, and the construction and working of it will form part of the Madras Railway system. This line is of much importance from a strategic point of view, and on that account it is believed that a broad gauge line to Guntakul has the support of the Military authorities.

SALEM WATER-SUPPLY.—The services of Mr. C. A. B. Target, Executive Engineer, 1st grade, was temporarily placed at the disposal of the Municipal Council, Salem, for the investigation of the various schemes proposed for supplying the town of Salem with water. The salary of the officer was to be met by Government and the travelling expenses during the period by the Municipality. The actual cost of the investigation was Rs. 3,472-11-3.

ANOTHER INVENTION.—Mr. A. Lyle has just introduced a very simple arrangement for fastening down Mangalore tiles on exposed roofs. It keeps the tiles perfectly secure against wind without the use of ceiling, and will be of great importance, because a roof exposed, such as a shed, can with this fastening be covered with tiles instead of iron. This will be an advantage where men are employed under sheds, as the roof with tiles is so much cooler.

TANK RESTORATION IN SOUTHERN INDIA.—It has been decided that zemindari and other private tanks and irrigation works shall not be estimated for by the Tank Restoration parties, unless the proprietors pay in advance the approximate cost of the investigations. In future the Board of Revenue and Collectors are to be consulted when the yearly programme of the Tank Restoration Scheme is prepared, the former as regards the districts the parties are to work in, the latter as regards the minor basins to be investigated.

UMBRELLAS!—The *Indian Mirror* says:—We have Jute Mills, Cotton Mills, and Paper Mills in the neighbourhood of Calcutta. We sincerely hope some enterprising millionaire will start an umbrella factory here. As much as Rs. 37,13,000 worth of umbrellas were imported last year. We had heard that a mill for manufacturing matches was erected in the Western Presidency; it should have an agent in Calcutta, so that those Natives who have sworn to use no foreign manufactures may have their scruples satisfied.

THE BURMA SAPPERS.—It would be interesting to know what progress, if any, has been made in enlisting men for the regiment of sappers and miners which was to be raised in Burma. The terms of enlistment in the corps have been published now for some months in the columns of the official *Gazette*, but how many men have joined and what progress has been made in drilling and disciplining them, we are left in ignorance of. It is believed that the restraint on their liberty and power to go where they like, will always act as a deterrent to the generality of Burmans subjecting themselves to military discipline.

A WISE RULING.—The Government of India have decided that, without special sanction, no officer of Government may receive furlough allowances while drawing

pay or allowances from another employer, and further that no officer whose services have been lent to another employer can take leave or obtain leave allowances from Government unless he actually quits his employment for the period of such leave. This ruling applies of course mainly to Engineers in the Public Works Department who take service temporarily in native States or with private companies. It will only apply to employment in India. An officer who really takes furlough to Europe can employ himself as he chooses.

EFFECT OF SEA WATER ON CAST-IRON.—"H. R. P. C." writes to the *Madras Mail* anent Mr. Mason's letter on the Madras Harbour in our issue of the 2nd instant, which was copied by all the South Indian papers:—With reference to Mr. A. H. Mason's proposal to introduce cast-iron pipes into the concrete blocks for the Madras Harbour, perhaps he is not aware that when cast-iron is immersed in sea water it becomes so soft that it can be cut by a knife. In the case of the *Maryrose*, a man-of-war sunk some time in Elizabeth's reign (the ship was raised early in the present century) the cast-iron balls on being exposed to the air became red hot, and when cool, were found to be only a mass of carbon.

THE DANDOT COLLIERY.—It is satisfactory to hear that the Dandot Colliery Works, in the Jhelum District, are progressing rapidly, and that the output of coal is all that can be desired. Indeed, it is anticipated that enough coal will be found to supply the whole of the North-Western Railway system for many years. If these pleasant anticipations can be fulfilled, and there seems no reason to doubt that they should be, and if, as is also anticipated, although in this case the prospect might not be so bright, the Biluchistan Railway system can be worked with petroleum from fields in that locality, the whole of the Western Frontier Railway system will be virtually independent of a wood-supply—a matter of no small importance.

A COMPLICATION.—The new building for the Huzur Treasury at Vizagapatam leaks so much that the Revenue authorities refuse to take it over. The leaks arise partly from sagging or movement of the timbers of the flat-roof and partly from the want of proper slope to shed off the water quickly. A supplemental estimate was necessary, and the Executive Engineer himself directed to see that this estimate was completely and clearly prepared, and that the specification of the work to be done was in full detail. He was also informed that, when the work came to be done, to give it all the personal attention in his power and see if he cannot remove to some extent the discredit which the state of affairs throws on the Department.

LATEST IMPROVEMENTS IN RAILWAY SLEEPERS.—We deal with truism when we declare that no sleeper, cast-iron or steel, hitherto invented and put to practical test is without its drawback, and the sleeper which forms the subject of this notice is no exception to the general rule. There are, however, features in the new-comer introduced by Mr. G. E. Moore, C.E., described elsewhere which places it far above those yet put on the market or examined by us, and we cannot resist the conviction which naturally forces itself upon us that it is *the best* of its class. The defects of the various patterns have been studied, and as far as possible, carefully avoided in the new device, and the advantages claimed by the inventor are such as should induce a very extensive application here, and elsewhere. We are very much impressed with the novelty of the arrangement, and have no doubt that its usefulness and efficiency

will be appreciated by those of our Railway Engineers who aspire to the conditions fulfilled by this invention.

THE EAST INDIAN RAILWAY COMPANY.—A contemporary observes that the East Indian Railway Company is destined to supply additional force to the official argument that it is already too powerful a concern for the public interests—a concern which is found difficult of reasonable control by the State, its master, and a bad neighbour to its younger brothers. So far, however, as mere capability goes, perhaps no new organisation can be better adapted for managing a second large system economically and well: though it would be perfectly feasible for the Government to do so by taking over the line itself and making it a State Railway. The East Indian is, however, fortunate in having a staunch friend in Council in General Richard Strachey. Would not a good deal of fruitless discussion be saved, if the Government of India once for all accepted the position, that any and every Railway question in which this country is concerned is as good as settled directly the gallant General, inspired by his disinterested adviser, Sir A. M. Rendel, declares himself?

"INFORMATION WANTED."—An advertisement thus headed runs as follows:—"Any person knowing the name of any other person who has been dismissed, without reason for the dismissal being given, by the E. I. R. Company, or knowing of any notice that has been issued to an employé that his services were (no longer required) without ascribing any reason, will please forward the information to 'Counsel,' care of Manager, *Morning Post*, Allahabad." We, ourselves, are in a position to adduce a recent notorious instance where an employé of the E. I. R. Company of 12 years' standing, who was known to be a *good* man, and who had risen from Rs. 250 to Rs. 500 a month, had his services most unexpectedly dispensed with *while on furlough*. The reason alleged—"reduction of establishment"—was at variance with facts, and publicity was hushed by some sort of compensation which the party concerned was obliged through necessity to accept. Our only reason for referring to this case is that insecurity of tenure of employments is prejudicial to the public interest, however blind or indifferent the Railway Company may be to the fact.

SANITARY HAND-BOOK.—Dr. McNally, of Madras, wrote to Government to know if it would be prepared to publish, a sanitary hand-book for the use of members of Municipal and Local Fund Boards and sanitary and medical officers of all grades. He alleged that the Municipalities and Local Boards Acts of 1884 invest the members of such Boards with powers nearly similar to those vested in corresponding "local authorities" in England under the Public Health Act of 1875, but the members of our Indian Boards are certainly less enlightened regarding sanitary matters than their English prototypes, and there exists no published work which can serve them as an adequate guide. The principal aim of the hand-book is to supply such a guide, and to explain the principles of modern sanitary science, with practical reference to India—Southern India in particular—in a form which shall be intelligible to men of ordinary education, like most members of Local Boards and medical subordinate officers, and assist them in the discharge of their public duties. Government are willing to undertake the publication of the proposed work.

SANITARY ADMINISTRATION IN CALCUTTA.—The *Lancet* of the 5th May says:—The Calcutta correspondent of

the *Times* has telegraphed that Dr. Simpson's statements as to the sanitary condition of parts of that city have offended the acute susceptibilities of the Native Commissioners; and that Dr. Simpson has been solemnly called upon, by a formal resolution, to explain away, or withdraw, his description of them as discourteous and disrespectful. Dr. Simpson's excellent work in Calcutta has been closely watched in England, as well as the difficulties with which he has had to contend; and the enemies of Local Government in India will not be slow to see, in the treatment he is receiving at the hands of the Native Commissioners, a strong reason for depriving them of a power which they appear unable to exercise with wisdom and justice. Certainly the sympathies of all right-minded persons in England will be with Dr. Simpson in his efforts to remove the causes of cholera from his district. This is, indeed, matter of more than local concern, and as such we do not doubt it will be treated. The maintenance of conditions which foster cholera in India cannot be disregarded by England, or even by Europe.

LUCKNOW ARTESIAN WELL.—The Municipality expended last year Rs 38,409 for purchase of plant, &c., for this experimental well. The result is so far a failure, the boring having run crooked. Further advance is in consequence out of the question. It has therefore been decided to give it up and start afresh at a spot four feet nearer the river. Hitherto the drilling has been performed by steam-power only; but it is said not to be the most effective for running through sand beds, and as numerous sand beds were met with in the boring which has just come to a standstill, and are expected to be met with again in the fresh attempt now to be made, it has been considered advisable to work through these by hydraulic-power. The necessary machinery has been accordingly ordered from America, and it is hoped will be out in time to admit of work being resumed by October. The outlay originally estimated was Rs. 60,000; this fresh machinery is estimated to cost about another Rs. 15,000; so the artesian well, when completed, if successful in this second attempt, will cost something not far short of a lakh of rupees. We are disposed to think that the undertaking has not only been badly managed, but the *modus operandi* appears to us to be a mere waste of public funds.

THE LEAKAGE FROM THE MALABAR HILL RESERVOIR.—Mr. David Gostling, F.R.I.B.A., having been asked for information on the subject of the Malabar Hill Reservoir, recorded his opinion that he was aware of a leakage from the Reservoir on the Nepean Sea Roadside, shortly after it was completed, but he thought nothing of it, as all reservoir walls and floors leak more or less. During a visit he made to the Kharakwasla Dams some years ago, shortly after the monsoon, he noticed that in a certain position the reflection of the sun on the outer face of the dam made it appear to be one huge mirror from end to end, nearly a mile long. This mirror-like appearance was due to the great pressure of the head of water, causing the water to ooze through all the pores of the chunam joints. He noticed the same effect on the outer face of the Tulsi Dam. He says that it is impossible to make any reservoir, even when constructed of pure Portland cement, absolutely water-tight. Chunam and cement are porous in different degrees. The water, oozing through, carries with it carbonate of lime in solution, and thus has the tendency still further to cause leakage. Gradually, however, these minute pores

act as a filter in catching vegetable and mineral matters in solution in the water, and therefore in the course of years have the tendency to close up. The facts requiring to be ascertained are "what fraction of a percentage the amount of leakage bears to the whole body of the water-supply in the respective places?"

NOTES ON PROGRESS ON PERIYAR PROJECT WORKS.—The road from the main Travancore road to Thekady camp, and for about a mile further to the point on the cutting where the materials will probably be shipped on boats, has been completed and gravelled. All surveys for the wire tramway line have been completed, the line finally decided upon and cleared from the bottom of the ghât to Thekady camp. Excavation has been done to some extent on almost the whole length of the Water-shed cutting and the line cleared to 10 feet depth to where the head of the tunnel will be. The exact line of the tunnel has been marked by a cut on the rock and by a line on a built stone. The electric apparatus has been used with success on the blasting. The effect of a dozen charges being fired exactly simultaneously, being conspicuously greater than the firing at different times by ordinary fuse. The reservoir dam has been commenced, and it is hoped will be finished before the close of the season. The line for the turbine supply channel has been laid out for the whole length from the Muliya Panjan dam at Kumuli to the tunnel mouth and extended to the point on the wire tramway line where the driving turbine will be. The final site for the *main dam* has been lockspitted on both sides of the river, and considerable clearing done. Rock has only been reached at a very low level. A small manual fire-engine has been tried with success in washing down into the river the earth excavated by hand. Twelve coolies work it, and it takes the place of about eighty women with baskets removing the spoil dug by twenty men.

GEOLOGICAL SOCIETY OF LONDON, 1888.—In presenting the Wollaston Gold Medal to Mr. Henry Benedict Medlicott, M.A., F.R.S., late Director of the Geological Survey of India at the Annual General Meeting, 17th February 1888, the President, Professor J. W. Judd, F.R.S., addressed him as follows:—"Mr. Medlicott,—The Council of this Society are not unmindful of the fact that many of our Fellows are engaged in the promotion of Geological Science in every part of a vast Empire; in awarding to you the highest honour which is at their disposal, they are following a precedent which was established more than fifty years ago, by the presentation of the Wollaston Medal to Cautley and Falconer. In that great Indian dominion where those famous geologists carried on their important researches, you commenced your labours as far back as the year 1854; and for more than a third of a century you have continued the almost incessant exertions which have led to very important additions to our knowledge, often obtained only at the price of severe hardships, and at the risk of serious dangers. During the last eleven years you have occupied the important and responsible position of Director of the Indian Survey; and it is to your administrative ability in that position that we owe many of the valuable results obtained by that Survey in recent years; more especially are we indebted to you, and to our Secretary, Dr. Blanford, for that useful Compendium of Indian Geology which has now become indispensable to all students of our science. We feel it to be singularly appropriate that we are able to make this award to you just at the time that you return to your native country for the rest you have so well earned."

Current News.

THE Oudh and Rohilkhand will become a State Railway from the 1st of January next.

LIEUTENANT EWBANK, R.E., is appointed to the Military Works Department for special defence works.

THE Secretary of State in answer to further enquiry has been informed that the Simla water-supply is not entirely satisfactory.

THE Punjab Government has just sanctioned an expenditure of Rs. 11,000 to complete the roofing and other works of the Simla Town Hall.

WE hear that the heat recorded in Calcutta during the past few days is the greatest chronicled in the history of the Meteorological Department.

THE *Times* states that Mr. Needham's expedition has proved that Railway communication is practicable between Assam and Upper Burma.

THE Directors of the Peninsular and Oriental Steam Navigation Company recommend an interim dividend at the rate of 5 per cent. per annum.

MR. RIBBENTROP is proceeding to Burma to settle the misunderstanding between the local Government and the Bombay-Burma Trading Company, regarding the forest contract.

MR. F. VINCENT, of the Madras Forest Department, has received the special thanks of the Government of the Colony of Victoria for a Memorandum prepared by him on the Crown Forests in Victoria, while on leave from India in that Colony.

THE gold medal of the United Service Institution in India for the best essay on "The Tactics of the Future" has been awarded to Captain Maude, Royal Engineers; *proxime accessit*, Major G. F. Young, second-in-command of the 24th Punjab Infantry.

THE Superintendent of Works finds it necessary to request that no further applications may be made for permission to visit the new Viceregal Lodge, as it is absolutely necessary to close the Building, in order to complete the decorations and furnishing.

THE Amir of Cabul has, we hear, sent two more regiments to Jellalabad to strengthen his force operating towards Bajour. Some seventy-five camel-loads of arms purchased by Mr. Pyne, his Engineer in England, have passed up the Khyber for Cabul.

THE Mysore Section of the Southern Mahratta Railway system which was constructed, and for several years worked by the State, shows but little signs of improvement in its traffic returns since the transfer of the property, now nearly two years ago, to the English Company.

THE subject of sanitation in India, both in rural and urban areas, has, a Bombay contemporary states, been for some time past under the consideration of the Government of India, and an important resolution on the question is likely to be shortly issued from the Home Department.

THE East Indian Railway, as usual, headed last year the list of Indian Railways in its percentage of net earnings on capital expenditure. These came to 8½ per cent. This Railway has kept steadily at over 8 per cent; its largest returns were in 1883, when they amounted to 8.99 per cent.

FAST improvements are being made in Keamari for the better accommodation of shipping frequenting the port. Eight new cranes have already been completed and thirteen more are in course of construction. One of these is of twelve-tons lifting capacity, already described in our pages.

WHILE Mr. Holt-Hallett is trying to induce the commercial community in England to take up the question of Railway communication between Moulemein and South-Western China, Mr. Robert Gordon, of Irrawaddy Engineering fame, calls their attention to a rival line which would link Yunnan with Rangoon.

THE Secretary of State's recent enquiries about the expenditure incurred on the Simla Town Hall have, we hear, been answered by the local Government to the effect that the Simla Municipality are responsible for the excess of actual expenses over estimates, inasmuch as they did not adhere to the plans approved by the Government.

DURING last year there were 24 factories working in the Madras Presidency—eleven of which are situated in the town of Madras. These factories gave employment to 12,588 men and women, and 764 children. The list includes Government and Railway factories and workshops, two or three sugar refineries, cotton presses, and a cotton spinning factory.

THE Government of India are now considering whether the policy of giving loans for what are known as local works may not be further developed. To begin with, entire control of these loans and advances will probably be entrusted to the local Governments, who will be allowed to open a loan account with the Imperial Government, paying the latter 4 per cent on all advances credited to them.

THE cost of Municipal original works Lucknow last year amounted to Rs. 98,223, which is in excess of the Budget allotment by Rs. 67,733. This excess expenditure is mainly due to the outlay of Rs. 38,409, for purchase of plant &c., for the experimental Artesian well, Rs. 21,969 for the construction of two pontoon bridges. The expenditure incurred on repairs during the year aggregated Rs. 28,665. The gross public works charge amounted to Rs. 1,30,024.

Letters to the Editor.

[The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

INFORMATION WANTED.

SIR,—Where can I find the thicknesses of sheet iron corresponding to the Nos. of the B. W. G. ? Molesworth's Pocket Book, edition 21, page 592, gives some information, but I do not think it is what I want. No. 1 is shewn as '004 inches ; and No. 36 as '167 ; and this is either wrong or else refers to some other gauge. I should feel exceedingly obliged if you would insert this in your valuable paper.

X.

"SIR CHARLES ELLIOTT AS A FINANCIER AND AS A FRIEND."

SIR,—The only explanation that can be found for the proceeding on the part of the Minister for Public Works, referred to in the article under the above heading in your last issue, is that his policy is likely to be at fault and may require bolstering up. But Sir Charles evidently forgets that the Government, by throwing in its lot with a private enterprise, shares in its fortunes, and in the event of a collapse, not only Government, but its irresponsible advisers come in for a portion of the odium attaching to the failure.

ANTI-JOBBERY.

LOCAL INDUSTRIES.

SIR,—Referring to your recent article headed as above, I beg to point out that there is another side to the question which is suggested by the way in which, I am informed, indents have been treated by a certain firm carrying on a local industry of some importance. This side of the question relates to the business-like conduct of the enterprise—the promptness, thoroughness, scrupulous care as to uniformity of quality. Without attention to these points the very best enterprise will languish, and to those who wish to succeed, it is very necessary to strongly advise them to treat their customers as though they were working against a keen competitor and to use every effort in supplying the proper thing in the shortest possible time. It is hoped that the unnamed firm will accept the hint and set their minds to inculcate the habits referred to, and a wider field of usefulness can, I am assured, be readily guaranteed them.

EXECUTIVE.

"A GLOOMY PROSPECT."

SIR,—Under the above head, in your "Notes and Comments" of 9th June, you state that there will be no compulsory retirement of a General Officer R. E., Imperial List, between the 20th July 1888 and 12th December 1891. This seems incorrect, for General J. F. M. Browne, C.B., will attain the age of 67 on 24th April 1890. Your informant on these points should study his "R. E. Journal" more attentively, as this is the second time I have had occasion to correct him.

The step on 20th July next will leave Sir Howard Elphinstone second from top of the Major-Generals, and it is therefore very unlikely that he will be compulsorily retired in December 1891. His promotion to Lieutenant-General before that date is almost a certainty, and this would give him 5 years longer to run. Assuming no steps to occur, except those due to compulsory retirement, your statement about him is quite correct.

D.

June 13, 1888.

WANTED—THE "CALCULUS" SIMPLIFIED.

SIR,—Your correspondent Mr. A. Ewbank has of late written on a number of subjects all of which are eagerly studied. May I suggest a few papers being given on the Differential and Integral Calculus. Your correspondent has a happy way of smoothing difficulties, and a few lessons from him would therefore be very much appreciated. The Calculus is popularly believed to be such a difficult subject that few care to approach it, and some of the present treatises on it are, I must say, well calculated to awe anyone intending to study it. Referring to these works, Mr. R. A. Proctor says in the preface to his own little work on the Calculus that the "plan pursued in them is as absurd as that by which children are taught rules relating to the philosophy of language before being taught how to speak." If Mr. Ewbank would therefore write a few articles in that clear lucid manner that characterizes his lessons, I am sure many would consider it a boon. I trust to be pardoned for the liberty I have taken.

MAULMAIN ; June 8, 1888.

STUDENT.

BELLARY DIAMONDS.

SIR,—With reference to the Madras Presidency Diamond Fields Company, the *Bombay Gazette* wants to know whether similar land to the blue clay it is now proposed to dig into for diamonds was not exploited without return in 1884, and rather inclines to laugh at the project.

But, the fact that diamonds were not found four or five years ago is not proof presumptive, or other proof of reasonable colour, that they are non-existent. Far be it from me to wish to encourage speculators by asserting that there are diamonds in the aforesaid fields. I know no more, have no more information on the subject than the man in the moon ; and have not the least desire to pretend to it. But I do not presume to say that there are no diamonds. Golconda is more than a tradition ; was once a reality, and might again become so with the aid of 19th century mechanism.

It was simply lack of mechanism to enable them to go further that induced Madras miners of by-gone centuries to abandon their gold findings. 19th century science has given a new impetus to that industry.

Diamond hunting seems to me to be as sound and "likely" a prospect as gold hunting.

Only let experienced men hold the helm. There ought to be no difficulty in getting them from the Cape.

COMMON-SENSE.

BLAME WHERE DUE.

SIR,—The cost of the new Viceregal Palace at Simla has been exciting unfavorable criticism. That is natural enough. The tax-paying public does not like being mulcted for Viceregal luxuries, and rightly extends its criticisms to outlay of public money expended on them. This has happened in the case of the Viceregal Palace, the cost of which is likely to exceed the estimates by some three lakhs of rupees. That is decidedly censurable ; but let the responsible people bear the blame. The new dwelling place was planned and estimated for, and begun, I believe, when Lord Lytton was at the head of affairs. His notoriety hunting successor, when he came into power, suspended all building operations till the materials gathered together for that purpose were found to be going to waste, and moreover that a Viceregal Residence at Simla had become a political necessity. Then, work was resumed, slowly and diplomatically, and with sparing expenditure of necessary bawbees. That is always bad economy ; always needs must cost more in the long run than avoidance of shilly shally. But I fail to see wherein either Lord Dufferin or the Engineers concerned are to blame in this matter. A penny saved is not always, or even often, a penny gained in the real sense of the word. All the world interested in the matter knew that in the interests of the Indian Government this mountain lodge would have to be built, and in such a climate delays could only mean depreciation of material and more or less entertainment of high priced labor without economical, or any other satisfactory result.

FACT.

CHOTA-NAGPORE.

SIR,—The Lieutenant-Governor's visit to this benighted province some months ago bids fair to be fruitful of some good to the people in the shape of material improvements to the public roads. The fifty-six miles of difficult hill road between Hazaribagh and Ranchi, over half of which is unbridged and unmetalled, are now in the hands of the D. P. W., who are busy re-grading the bad bits to a maximum of 1 in 30, and re-aligning those portions where the above maximum involves heavy rock cutting and blasting. The Ranchi-Silli Road is also undergoing a similar process. The whole project includes several bridges over nalas and nadis, the principal of which are the Subernareka and the Chouta, both being brick arched bridges of several spans of 30 and 40 feet on coursed rubble piers and abutments. The locality affords excellent sandstone in abundance, and Messrs. Mitchell and Co., of Calcutta, are doing their best to push on the works. Mr. Christie, the Executive Engineer, and his staff have a busy time of it, and ere we are two years' older, Chota-Nagpore will be one of the civilized provinces of India.

It does not, however, appear that the bridging of the Barakar on the Giridi-Hazaribagh Road, and the Damuda at Ramghur is intended at present, although the Hazaribagh Association in their address to the Lieutenant-Governor pressed this matter upon His Honor's consideration with a formidable array of facts and figures. No one who has travelled in this province during the rains can have helped wishing that the so-called Public Waste Department had, before anything else, wasted a few lakhs in bridging these rivers, where travellers have often to wait for hours and hours together in the midst of a long and tedious journey before they can safely get across.

NON-REGULATION.

"IRRIGATION PROJECT MANIA."

SIR,—Under the above heading, in your issue of the 2nd instant, there appears a letter signed "Prudence," which is, I think, somewhat misleading. If Madras Engineers are not more careful than your correspondent before they give their ideas to the public, we may well expect failures. I am not prepared

at present to go into the financial results of the Madras Water and Irrigation Scheme which was prepared by the late Mr. W. Fraser, but accepting your correspondent's figures as correct, the comparative failure may, I think, be clearly ascribed to the absurdly low price at which the water is sold to the Madras Municipality. It would produce a much larger revenue if it were used solely for irrigation. The annual loss may be looked on as the price paid by Government for good water for Madras, and considering the interests involved, it is money well spent. I must take exception to the statement that the scheme "has the command of a river that is flowing throughout the year." No one with any knowledge of the Cortelliar River would make a mistake of this sort. That river is practically dry for the greater part of the year like all the short rivers on the east coast of the Madras Presidency.

"Prudence" has not taken the trouble to make himself acquainted with the outlines of the Periyar Project, or he would hardly have fallen into the error of supposing that the ryots will have to live and cultivate in the malarious jungles he so graphically describes; the reservoir is to be in the hills in an unhealthy locality, but the water from it will flow through the plains of the Madura District, where there is a dense population, well accustomed to wet cultivation and eager for the bountiful supply of water which the scheme promises to give them as an addition to their ordinary precarious supply.

I cordially agree with your correspondent about the repair of old irrigation works. A great deal has been done during the last ten years, but the works are so numerous, and the officers of the Public Works Department so overburdened by their multifarious duties, while funds are short, that it will be long before all these works are put into a satisfactory condition. Apparently "Prudence" would borrow money to repair old irrigation works instead of spending on them a certain proportion of the revenue; this course will hardly commend itself to those who have the best interests of the country at heart.

DELTA.

June 9, 1888.

"AGRICULTURAL SHOWS."

SIR,—As you state in your issue of 2nd June that you would like to hear something about Agricultural Shows of Northern India, I have the pleasure of forwarding some notes on the same.

On the 21st February 1888 a District Fair was held at Saharanpur about which the *Civil and Military Gazette* says: "The Agricultural Show was arranged in five departments, viz., (1) Cattle (2) Agricultural produce, (3) Agricultural implements, (4) Ploughing matches, (5) Gardening produce.

"The cattle and poultry are hardly worth remark; of the former there were some fine bulls, but they are scarce this year.

"The Agricultural produce was good in its way.

"The centre of attraction for bucolic minds, and indeed for other minds of superior intelligence, was the Agricultural implements, and notably the sugarcane mills. The Beehea mill was, as on the former occasion, debarred, and the contest laid finally between Mr. A. Rogers' and the Nahan Foundry mills, with result that out of 20 seers cane, the former produced 11½ seers and the latter 12 seers. Mr. Rogers' mill is well known, but the Nahan mill has, I believe, now entered the list for the first time. It is evidently of great crushing power and consists of three cylinder rollers placed vertically."

As stated in the above paper, the competition between the sugarcane mills was the most interesting part of the Exhibition, and, from the way prizes were awarded in this department, one can come to a very accurate idea of the way in which these shows are managed in general.

The *Civil and Military Gazette* seems to have been under the impression that the mill which competed against Mr. Rogers was the Nahan three roller mill. This however was not the case. It was a two roller mill which extracted half a seer more juice out of 20 seers cane or, say, 2½ per cent. but it certainly took more time to finish its work, for which reason the Committee decided to give Mr. Rogers the 1st prize and the Nahan the 2nd, against which I protested, pointing out that the reason why the Nahan mill took longer to do its work was owing to its working under great disadvantages.

1st.—The mill had been fitted up between two trees, which prevented a lever of the proper length being used.

2nd.—The man who had fitted up the mill was a carpenter, who had never worked a mill before, and had been sent down to carry out the orders of one of our men then exhibiting the "Nahan" mill at Muradabad. The Muradabad Exhibition, having been postponed at the last moment, the man did not turn up, and therefore, the mill was not properly erected. Under these circumstances I requested that a second trial should take place after my mill had been properly set up. This the Committee declined, stating that though the Nahan mill extracted more juice, it required more power to drive.

In this case one mill produced more juice, but the other did its work in a shorter space of time, so that at least there was some reason for awarding the prizes as was done, though the Committee afterwards awarded my three-roller mill a 1st prize also.

Mr. Rogers' mill, known as the "Saharanpur," and the "Nahan" mill met again at the Nochandi Fair, of Meerut, later on, where a competitive trial took place between three mills—the "Nahan," the "Saharanpur" and the "Rajah." The following being the result:—To each mill one maund of cane was weighed out, and they were then set to work at the same time. The "Nahan" finished crushing the cane first, the "Rajah" three and the "Saharanpur" fifteen minutes after. The juice extracted by the "Nahan" and the "Rajah" was equal in quantity, but the "Saharanpur" extracted 12 chataks less.

One would naturally expect that the "Nahan" mill would have got the 1st prize, but no, the first prize was again given to the "Saharanpur," the "Nahan" obtained the 2nd. The man in charge of the "Nahan" mill represented to the Collector the unfair way the prizes had been awarded, but the Collector refused to go into the matter as he was leaving for England the next day and had no time, but advised the man to appeal to the Committee, which he did, but received no satisfaction. When this was brought to my notice I wrote to the President of the Committee and received the following answer:—

Letter from the President.	Remarks.
DEAR SIR,—In answer to your letter of the 26th instant, I may briefly say that three mills competed—(a) the "Saharanpur," (b) yours, (c) the "Rajah." All mills obtained 17 gallons of juice out of one maund of cane. Yours finished a couple of minutes before the "Rajah" and some 8 or 10 minutes before the "Saharanpur," though this great difference was apparently the fault of bullocks. The "Saharanpur" mill had best lubricating arrangements, yours next. The "Saharanpur" was most readily taken to pieces and put together again. The "Saharanpur" had least refuse in the juice and so on. I am now only talking from memory, and your mill was only 3 marks behind, out of 50 points.	(1) 17 gallons would be over a maund in weight. (2) The lubricating arrangements are on the same principle in both mills. (3) The "Nahan" is a simple mill having fewer parts, and can therefore be taken to pieces in a shorter space of time. To dismantle the mills it took the following time:— Minutes. The "Rajah" 30 The "Saharanpur" 9 The "Nahan" 3

Again, at the Muradabad Exhibition I sent two mills, a three-roller double squeeze and a two-roller mill, with the special request that the three-roller mill should compete with other mills. At this place four different mills competed; below is a table shewing results:—

Name of Mill.	Sugarcane crushed.	Juice extracted.	Time occupied.
	Seers.	S. ch.	
Puran Mul 3-roller mill	16	9 1	Took so long, time not taken.
Native made mill	"	10 10	Do. do.
Name not known	"		
Mr. Rogers' Saharanpur	"	13 8	30 minutes
Nahan 3-roller mill	"	13 13½	20 minutes

Here, as at Saharanpur, the competition lay between the "Saharanpur" and the "Nahan." The latter extracted more juice in less time, but the 1st prize was again given to the "Saharanpur." The "Nahan" mill, besides having demonstrated its greater crushing power, has the additional advantage of being considerably cheaper than the "Saharanpur." Now, I ask, Mr. Editor, why in all these cases did the "Saharanpur" mill get the 1st prize when in common justice the "Nahan" was entitled to it. As stated above, at Saharanpur there was an excuse for awarding the 1st prize to the "Saharanpur" mill, but at the other two places not the slightest.

Since the last Shows took place, I have improved my mill materially and am now anxious to bring the improvements to the notice of the cultivators. There is no better method of doing so than by exhibiting them at Agricultural Exhibitions. This, however, I hesitate to do after the experience I have had of these Shows, and, no doubt, there are a good many other would-be exhibitors who keep aloof for the very same reason. In a country like this where the cultivators place so much faith in the opinion of the Collector or the Deputy Commissioner of their district, the latter should be careful in the way they decide for or against an article.

There is a great need of reform in conducting these Shows, and if you would take the matter up in your Journal, and advocate stringent rules and regulations by which in future prizes may be awarded by competent judges, they would doubtless be enforced, and you would be doing the public a great service, as the awards given at these Shows are afterwards used as advertisements to mislead the public.

NAHAN FOUNDRY; 14th June, 1888.

T. R. JONES.

Literary Notices.

A HIGHER ARITHMETIC AND ELEMENTARY MENSURATION.—By P. Goyen, Inspector of Schools, New Zealand.—London: Macmillan & Co. 1888.

THIS book must be characterised as a bold attempt in a subject which has already exercised the knowledge and experience of some of the best known Mathematical Tutors of the old country. There is nothing that is novel in the mode of treatment of the arithmetical part of the book, and we are disposed to think that the mensuration part of it is a failure. While there is much in the book that we cannot recommend, nevertheless it may meet a want in the Colonies with the educational requirements of which the author should be well acquainted.

JOURNAL OF THE PUBLIC HEALTH SOCIETY FOR CALCUTTA AND ITS SUBURBS. Vol. iv.—Part I, 1888.

THOSE to whom the Calcutta Public Health Society is a stumbling stone and rock of offence, will see from the Annual Report just published, that that useful body is neither dead nor asleep. Its Council deserve the thanks of the Calcutta public for the information which is focussed, so to speak, in the pages of the first part of Volume IV. of the Society's Journal. Through good report and bad; in spite of the deliberate misrepresentations of its enemies as to the aims of the Society; and notwithstanding the strained efforts of those—some in high places—who dreading the independent criticism of an enlightened and representative body outside themselves have done their best to injure it, the Society has worked on bravely under obloquy and reproach, and the Report before us shews no signs of abatement of the disinterested zeal and unflagging energy with which its Council is imbued. Even those who may differ from some of the conclusions arrived at in the Report, must acknowledge their obligations for the mass of facts so concisely brought together in its pages. If the Society had done no more than to publish the Reports it has issued annually it would have deserved the thanks of the community.

After dealing as usual with the mortuary statistics of the town and suburbs, the present Report discusses the following subjects—the Filtered Water-Supply, the Reservoir in Halliday Street, Drainage, Conservancy, Building Regulations, Private Privies, Mahomedan Burial Grounds, the Milk Supply, the Prevalence of Leprosy, the Municipal Bill, Mr. Cotton's Chairmanship, Mr. Justice Cunningham's Lectures on "Public Health in India," the need there is for General Boards of Health, and the Amalgamation of Town and Suburbs; and it closes with a graceful reference to the recent death of the Honorary Analyst of the Society—Mr. Gustav Mees.

The first place both in respect of order and of detail in treatment has very properly been accorded to the filtered water-supply. The Report shews plainly that undue deference to the clamorous demands of the Hindu Commissioners in past years was the primary cause of the water trouble; and we quite agree with the Council in the view that true economy would have been secured by a more liberal expenditure at the outset. It would have resulted in a great saving of public money, to say nothing of the lives of thousands who have been cut off by preventible diseases in the twenty-odd years which have elapsed since pure water was furnished to the city. We trust the lesson will not be lost on the Commissioners in whose hands the sanitary agencies of the town are now placed; and that when they come to deal, as they will shortly, with the enormous task presented by the filthiness which prevails all through the suburbs, they will see that the cheapest way to improve urban or suburban districts is to deal with them in a thorough and efficient manner at the outset. A few thousands of rupees cut off estimates at the initial stage of great undertakings usually results in a few years in a tenfold increase in expenditure. The Council have, in our opinion,

made out their case for the need of a very large increase in the quantity of water which should be supplied to the town, and this without reference to the supply which will have to be provided for the suburbs. Efforts to check negligent waste must have the sympathy of all, but we hold with the Report before us that these efforts must not be confounded with any scheme which would aim at making 30 gallons of water do the work of 70 or 80 gallons. A tropical city like Calcutta should have a supply of filtered water giving not less than 100 gallons per head of the population.

Building regulations have also been treated at some length. Here again we consider the Council have struck at another of the main roots of the insanitary condition of this city. We never have had the least regard for the arguments so often urged by the defenders of dirt in Calcutta, who advocate delay and plead for more experience! The Report has some excellent references to the opinions expressed by Sir Ranald Martin fifty years ago, on the evils arising from defective structures. There are numerous localities in Calcutta itself to which Sir Ranald's strictures still apply; once across the Mahratta Ditch, and the conditions which he complains of become the universal rule. For ourselves we cannot understand how the Government suffer men who talk as certain Commissioners referred to at page 30 of the Report are said to have publicly expressed themselves, to rule the sanitary destinies of such a centre of commerce as Calcutta. We entirely concur in the opinion that what is needed is a stringent Building Act, and not the incomplete provisions which have been embodied in the new Municipal Bill. In view of the watch its enemies keep on its utterances, the Health Society has done wisely both in this portion of the Report and elsewhere, in quoting largely from those who have spoken already and some of whom are accepted by the Hindu Commissioners as authorities whose opinions cannot be safely gainsaid. There is just one point to which we should have liked the Report to have called attention, in this connection, and that is the disgraceful practice followed by the Corporation itself, of filling-up old tanks with street rubbish. Not only is it a most unhealthy practice while in progress, but made-land is decidedly objectionable as a building site. It gives a foundation which is saturated with organic matter in course of decomposition, and sinkages are almost certain to follow in buildings erected on such sites. Here again we have an instance of the short-sighted policy which marks so many of the proceedings of the Corporation; street sweepings in the long run are about the most costly material which could be used for filling tanks, and yet the Commissioners defend the practice on the score of economy! The use of street refuse and sweepings for filling tanks should be declared illegal by every Municipal Act worthy the name. Some of the most important accessories to buildings—privies—are noticed under a separate heading. The Council is perfectly correct when in speaking of the defects which prevail in native houses as regards their privy arrangements, they say in their Report, page 31: "In any other civilized city of modern times they would be doomed on a first inspection, and the reforms indicated by sanitary science would be rigorously and promptly carried out." This surely is a matter in which the public, and indeed the Government itself, should support Dr. Simpson against the native Commissioners who oppose him, as they have opposed his predecessors, in all efforts to effect reforms in the structure and arrangements of privies, where conditions are daily created which threaten to imperil health and life.

There are other subjects in the Report which would be more suitably reviewed in a Medical or a Sanitary Journal,—we refer to the milk supply, and the prevalence of leprosy; but while this is so, we cannot but thank the Council for giving prominence to the facts brought forward under these headings. We have visited *goallabaries* like Dr. McLeod, and in common with probably all our readers, we have seen the unfortunate victims of leprosy roaming unmolested through crowded bazars, and

even selling and preparing food for sale, and whatever may be the results which follow from the publication of the Health Society's Report, the Council deserve the thanks of the community for speaking boldly and opportunely on these topics.

Many who advocate, as we do, the amalgamation of the town and suburbs will realize what a tremendous undertaking the improvement of such localities as Kurryah and Hathibagan must prove. Multiply the task presented by the *bustees* at Kurryah and Hathibagan a hundredfold, and some approach is made to the task about to be imposed on the Corporation. It is a task which must be undertaken, and it is one which must be executed in no half-hearted fashion. A water-supply and a good drainage system will have to be applied to the suburbs within five years of the amalgamation; streets have to be run through all parts of the district in place of the tortuous lanes which now exist; extensive levelling operations, the clearing away of jungle, the improvement of hundreds of *bustees* of the type furnished by Kurryah and Hathibagan, and the rigid enforcement of building regulations, all these reforms will find a place in the programme about to be presented to the Commissioners. The suggestion that Government should aid in the work is an excellent one. The native Commissioners who can see nothing in the Health Society but an organization for destroying Local Self-Government, should read with satisfaction that the Council recognize the responsibility of past Government administrations for the sanitary defects of the suburbs, and that they urge more strongly than ever we have heard any Hindu Commissioner urge, that Government should come to the rescue in this matter. The Imperial and Commercial interests at stake alone suffice so to distinguish Calcutta from a host of other minor Municipalities, that Government concessions to the local Corporation could be no precedent for any Local Board beyond its precincts. In view of the increased responsibility implied by the amalgamation, there can be no question that the Government of India should carefully consider the weighty utterances of Sir Douglas Galton quoted in the Report in regard to the need for supervision. Our own opinion so entirely coincides with that of the Council of the Health Society that we would advise perusal of what they say on this subject.

There are two features in the Report to which we must refer in closing: one is the careful way in which the Society has as far as was possible expressed its views through the utterances of men who cannot be said to have had any partizan opinion to urge, and who have spoken up as fearlessly as the Society does in the Report before us. The other point is the clearness with which it is shewn that the arguments so constantly urged by the Hindu Commissioners against reform on religious grounds are a mere blind. We ourselves have long observed that when a man or a party is fairly "cornered" on any subject of sanitary reform in India, resort is at once had to what is termed for the nonce, the infringement of religious or caste customs. In the words of the Report, page 31, "Events may be waited upon too long, especially where human health and life itself are concerned; and it must be remembered that the real question in all these cases is whether or not reform is imperatively necessary. If it is so, it ought to be carried out." Toleration is an excellent thing; but it is a mistake in Government to let so-called sectarian toleration result in an intolerant disregard for the unyielding and inflexible laws of nature enunciated in the teachings of sanitary science.

THE LEAKAGE FROM THE MALABAR HILL RESERVOIR.

We have received the report of Mr. S. Tomlinson, Deputy Executive Engineer in charge of the Water Works, on the condition of the Malabar Hill Reservoir. In inquiring as to the causes of the leakage, the object has been, we glean, to determine the character and volume of the streams on the Chowpati and Nepean Sea Road faces of the Hill, and the relations between income and outgo of the Reservoir and the relative watertightness of the different portions of the Reservoir. Mr. Tomlinson, at the outset, explains that the streams consist

partly of water from the Hill, and partly of water which has leaked from the Reservoir.

It is explained that the determination of the relations between the income and outgo from the Reservoir by direct observation, is rendered somewhat difficult by various local circumstances.

Subject to these difficulties, several gaugings have been taken, and the leakage arrived at as nearly as possible, after allowing for the different known losses by supply and evaporation.

The history of the Reservoir is detailed. The work was commenced early in 1877, the tender of Hajee Kassum Jacob being accepted.

The work was taken out of the hands of the Contractor in January 1880, and no further progress was made until September of the same year. The water was admitted into the Reservoir on the 1st January 1881, when it was found to be sound and water-tight. The construction of the filters, which had cost Rs. 1,23,229, was completed in April 1883, and the roofing was completed in June 1887.

After detailing the history of the Reservoir, Mr. Tomlinson describes the design and construction.

The leakage is believed to be principally through the floor of the Reservoir, and a detailed history is therefore given of its construction. The floor, it is explained, was not founded entirely upon rock, but no part of this foundation, whether on rock or on moorum, could be relied on as being water-tight. The first contract, according to which the floor was to be excavated to a perfectly true face and afterwards to be covered with a layer of concrete a foot thick, which was not, however, carried out.

Mr. Tomlinson describes at some length the revised specification for the floor, and explains how the design of the Executive Engineer was modified at the request of the Consulting Engineer, the late Mr. Forde. The correspondence, bearing on this point, commences with a letter from the Municipal Commissioner, Mr. J. H. Grant, to the Town Council, recommending that, before accepting any tender for construction of filters, it would be advisable to complete the flooring, &c., as originally designed, in order to test the efficiency of the Reservoir. The Town Council resolved to do this on 13th April 1880, subject to such modification as the Consulting Engineer might suggest.

Having quoted the correspondence which had passed on the subject, the requisite remedial measures are recommended.

New Books and Reprints.

TRADE, COMMERCE, MANUFACTURES.

- ARNOLD (E. L.) Coffee; Its Cultivation and Profit. 8vo. Whittingham ... 10/6
 ART of Tea Blending: A Handbook for the Trade, 3rd ed. Cr. 8vo. Whittingham ... 3/6
 CHAPLAIN (J. G.) The Three Principles of Book-Keeping: A Popular Treatise on the Theory and Practice of Accounts. Post 8vo, pp. 126, Low ... 2/6
 HARRIS (George F.) Granites and our Granite Industries. With Illusts. Post 8vo, pp. 140. Crosby Lockwood ... 2/6
 HUSMANN (G.) Grape Culture and Wine Making in California: A Practical Manual for the Grape Grower and Wine Maker. 12mo, pp. 380. San Francisco ... 10/
 JOLLY (A.) Conversion of Weights: Tables showing the Live and Dead Weight of Cattle, Sheep and Pigs in Imperial Stones of 14lbs., in Smithfield Stones of 8lbs., in cwt., and in Scores, sinking the Offals. 64mo. Caster (Peterborough) Simpkin ... 1/
 KNIGHT (R.) The Practical Boiler Maker, Iron Ship Builder, and Mast Maker. 4th ed. Post 8vo, pp. 150. Wyman ... 5/
 SILBERBACH (J. H.) A Handbook of Vegetable and Mineral Products of all Countries Imported into Great Britain, Geographically Arranged for Use in Schools. 8vo, sd., pp. 30. Journal of Commerce (Liverpool) ... 6d.

ART AND ARCHITECTURE.

- BAYLISS (Wyke) The Higher Life in Art. With a Chapter on Hobgoblins by the Great Masters, 2nd ed., 8vo, pp. 196. W. H. Allen ... 6/
 DECORATOR'S ASSISTANT: A Modern Guide for Decorative Artists and Amateurs, 3rd ed., revised. Post 8vo, sd., pp. 160. Crosby Lockwood ... 1/
 DELAMOTTE (P. H.) The Art of Sketching from Nature: with examples from English Masters and well-known Water-Colour Artists. 2nd ed. Fol. Bell and Sons ... 21/
 TRINITY Church, Boston (Mass.).—Monographs of American Architecture. No. 5: A Portfolio giving 22 Gelatine Views and one Heliochrome of this Church. Boston ... 50/

General Articles.

THE BETWA CANAL, NORTH-WEST PROVINCES. III.

THE following are extracts from the comments made by Colonel Greathed on the Regular Estimate framed in 1874:—

After a very careful consideration of the subject, the head of the canal has been fixed at Pareecha, 13 miles east of Jhansie, near the Calpee road. This is the best site that could be found; a rocky barrier runs across the bed of the river, forming an excellent foundation for the weir. This barrier is said by the Executive Engineer, Mr. Dubus, to be free from cracks and fissures visible to the eye. The river has a straight run between good stiff banks, and there is a plentiful supply of good building stone, suitable for coursed rubble, in the neighbourhood. The bed of the canal is so determined as to bring its water to the surface of the country at Mot, where the two rivers Pahooj and Betwa begin to diverge. Flow irrigation becomes possible at this "obligatory point."

Mr. Hair has designed the canal to carry 600 cubic feet per second only, which is the volume attainable in early rubbee, as shown above. The bed is 20 feet wide, the depth of water 7 feet, side slopes 1 to 1. Above the water line the slope is expanded to 10 to 1 in deep cutting. To enable the canal to be easily modified, to carry 1,000 cubic feet per second in monsoon khureef at a future day, it is not necessary to alter the wetted part of the section shown on Sheet No. 1 of Atlas; but by throwing back the sides of cutting in the manner shewn on the drawing by thick black lines, and leaving berms 6 feet wide on either side, the width of the bed can at any time be increased to 30 feet in width by merely removing the berms and deepening the channel 1 foot. The bed thus enlarged will carry 1,000 cubic feet.

The effect of this alteration in the design of earth-work of the main canal will be to increase the quantity by 7,413,120 cubic feet at Rs. 3-8 per cent. = Rs. 25,945, which amount has been added to Mr. Hair's estimate.

From Pareecha to Reo the canal runs in a direct line, and is in excavation, varying from 30 feet at head to 5 feet, the slope of bed being 1 in 2,877. At mile 19½, or 3 miles beyond Reo, it bifurcates; the right or Humeerpoor Branch follows the watershed bordering the Betwa, and will irrigate the stretch of land lying between the high bank of the Betwa and the great mar basin in the centre of the Doab.

Mr. Hair has designed the weir alignment most skilfully, so as to make the most of the rock barrier already described: the weir is placed on the ridge of the reef, curved on the left flank convex to the direction of the stream, so that the water will be thrown towards the middle. The sill of the weir has been fixed in reference to the level of the 'Obligatory Point' at R. L. 625.50. The height of the weir above the river bed varies between 25.5 feet and 4 of the foot, except on the left flank, where the rock is higher than the sill, and will have to be cut down. The total length of the weir between the steps at either end is 2,396 feet, or nearly half a mile; and is calculated to produce an afflux of 6.5 feet.

The maximum flood volume of the Betwa has been calculated by various observers to be about 750,000 cubic feet per second; and it is this volume which gives an afflux of 6.5 feet. This flood discharge has been verified by a computation based on the area of the catchment basin, which is roughly 185 miles long and 48 miles wide, or 8,992 square miles. Allowing 80 per cent. of the rainfall to pass off, which is a reasonable allowance on rocky land of rapid slope, these results give a calculated flood discharge of 799,440 cubic feet.

The cross-section proposed by Mr. Hair is a trapezoid, with sides of equal slope, viz., 10 horizontal to 25½ vertical, the top width being 10½ feet, increased by a ledge to 15 feet. The section proposed is stable, but the

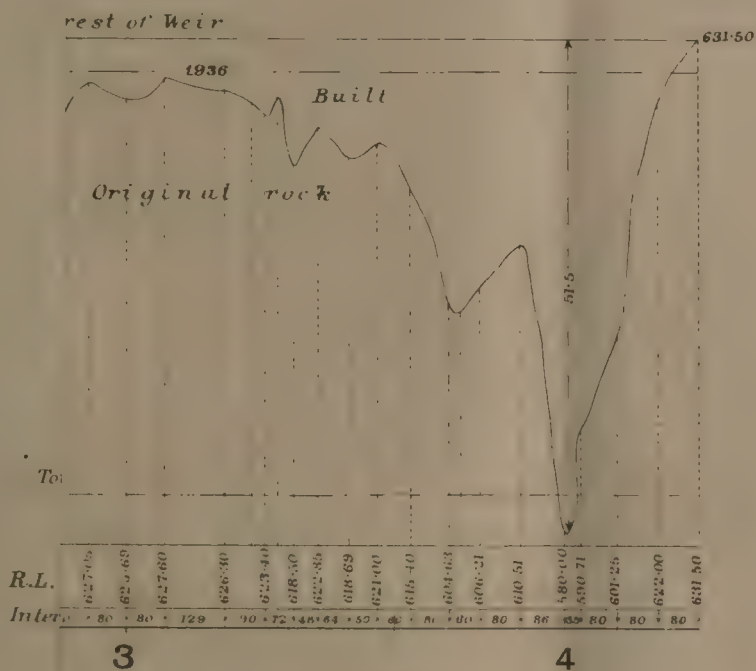
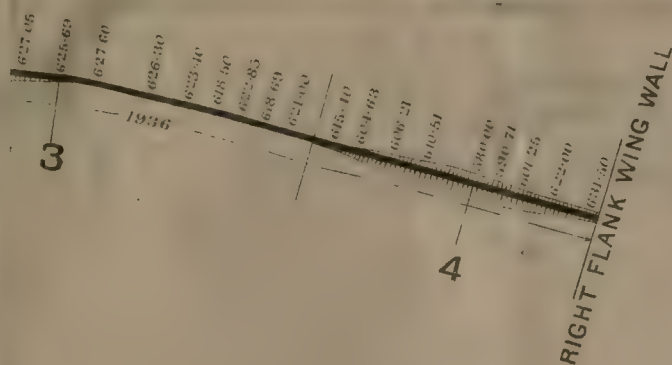
Chief Engineer does not approve of the slope on the down-stream side: a 6-inch film passing over the weir would fall, theoretically, at a point 6 feet measured horizontally from a line drawn plumb to the lip of the weir. Practically this distance would not perhaps be more than 4 feet, in which case the falling water would strike the down-stream slope of the weir at about half its height, and would ultimately affect the stability of the structure by wear and vibration. The down-stream face of the weir should therefore be nearly plumb; but to increase the stability of the work, and thereby to decrease its cost, the base of the weir has been extended up-stream as far as is consistent with the necessary conditions defined above. The up-stream edge will be rounded, as in certain works in Madras, in order that drift wood may pass over without obstruction and injury to the masonry. Instead of a batter for the up-stream face, the Chief Engineer prefers a curve, which facilitates the passage of water and drift; the curve is so designed as to reduce the thickness of the weir in proportion to the pressure exerted. The section shewn is for the highest part, and so much of the section, measured from the top downwards, as is requisite for the completion of the weir to a uniform still level will be built throughout the length of the structure. Fifteen feet has been adopted as a convenient uniform dimension for the width of the weirs at top.

In order to avoid inundation by the afflux caused by the weir, and to prevent water passing round the ends of the weir, embankments will be required on both sides of the river. The formation width has been fixed at 20 feet, and the level at 658.00, or 3 feet higher than allowed by Mr. Hair. The portions near the weir, which are liable to scour, will be pitched with any stone, and the bank itself will be hearted with a puddle wall 3 feet thick.

In a Note by COLONEL J. CROFTON, R.E., Inspector-General of Irrigation Works, he observes: on the *Dam and Head-Works*:—The maximum discharge of the Betwa in flood is calculated at 750,000 cubic feet per second. The calculation is based on a measured discharge of the river on the 10th September 1869, which amounted to 45,150 cubic feet per second, through a sectional area of 14,492 square feet, giving a mean velocity of 3.11 feet per second. The sectional area of the maximum flood is stated to have been 88,018 square feet. The mean velocity would therefore be $\frac{741,200}{88,018} = 8.42$ feet per second. These results agree very fairly with those deduced from an estimate of the proportion of rainfall running off the catchment, see annexure by Captain Marshall to Colonel Brownlow's Note, No. 674½, dated 1st April 1872.

Now, in the calculation of the afflux at the proposed weir, the velocity of approach is left out, because, Mr. Hair states in a foot-note to his calculation, it made no appreciable difference in the result. What velocity he assumed in his calculation is not shewn in the papers, but taking it at 8 feet per second, I calculate that a discharge of 751,908 cubic feet per second would cause an afflux of only 4 feet instead of 6½ feet, so that the works on the flanks of the weir and the afflux embankments would seem to be 2½ feet higher than is necessary. Again, the walls and top of embankment are designed 6 feet above the surface of highest flood. This is, I think, an excess of precaution. Three feet, or at the most 4 feet, would be ample.

If the maximum discharge of the river does not exceed that assumed, and there seems every reason, I think, to suppose that it is rather over than under the mark, the height of the head-works and river embankments might, according to the above calculation, be safely reduced 5½ feet. It is, besides to be borne in mind that the coefficient (0.628) used in the formula for calculating the afflux is only applicable when there is a deep pool above the weir: and when this pool silts up, as it will ultimately to a great extent, if not entirely the velocity of



S^o R. W. L. HAWKINS
Executive Engineer
B.C. Division 26.6.86.

the current immediately above the weir will increase to a certain extent, and consequently the height of flood will be something less than calculated by the formula.

The body of the weir is thicker than is perhaps absolutely necessary; but in a river with so steep a slope, and subject to floods of such magnitude, it is well to be on the safe side.

The top width might, however, with safety be reduced to 12 feet along nearly one-half of the length where its height above the rocky bed is inconsiderable. It should all be built of *uncoursed* rubble, which the experience in similar works in France and lately in Bombay has shewn to be much superior to coursed masonry for this description of work. The Doomagoodiem weir, on the Godavery, also goes to prove that good rubble in cement is at least equal to, if not superior to, ashlar for the coping. That work has now been standing for about six years, and has suffered little or no damage though exposed to exceptionally violent action. The cement with which the work was built was manufactured on the spot from material obtained in the vicinity.

The top of the weir should be countersloped upstream to facilitate the passage of trees or other floating substances over it. The edge is rounded off in the design, but this would not answer the purpose.

No provision is made in the estimate for protecting the bed below the weir from the scour and the impact of the falling water. It is stated that the reef of rock on which the work is to be constructed is free from cracks or fissures visible to the eye; if any should hereafter be discovered, they must be carefully filled with masonry in good cement.

Observations are made on the above Note by COLONEL W. H. Greathed, C.B., R.E., Chief Engineer of Irrigation, N.-W. P., who says:—

Colonel Crofton considers that the height of the head works and of the river embankments against afflux may be lowered 5½ feet in height. This recommendation is based upon three assumptions:—

I.—That R. L. 751.908 is the highest possible flood.

II.—That the rainfall adopted as a basis of calculation in Colonel Brownlow's note of 1st April 1872, is a maximum, and that the proportion there supposed to run off cannot be exceeded.

III.—That the bed of the river in front of the dam will silt up.

Concerning flood volumes and rainfall, our observations are so limited in extent as to be in my opinion unreliable as maxima. We know from experience how invariably "unprecedented" floods occur in large rivers of which the phenomena have been closely studied and watched for a series of years, upsetting all calculations. Something of the kind has even now occurred, I believe, on the Beas; and in the present state of our experience of the Betwa, I am unwilling to base designs on any close estimate of probable highest flood.

The subject was very carefully considered when the designs were determined, and I am not prepared to relinquish any of the margin of safety given to the head-works.

Regarding the possible silting up of the Betwa in front of the dam, we have no experience, I believe, to guide us. Nowhere, as far as I am aware, has the stream of such a river, filling during the flood season, a rectangular rock channel forty feet in depth, and moving with terrific violence, been barred by any artificial work and no experiments ever yet made can certify what the velocity of such floods will be at the bottom of such a channel.

On this point turns the question whether, and, if at all, to what depth the shingle brought down from the Vindhya can rest on the bottom of the river, and raise the bed in front of the weir. Colonel Crofton would have the works designed on that assumption. I cannot rely on a conjecture that the afflux will never be more than is calculated by the Inspector-General, and prefer to maintain the provision of the estimates.

The strength of the body of the weir is purposely in excess of the minimum of safety. The top width was studiously designed of width sufficient to afford a roadway during the eight months of the year in which it will be dry, for which purpose 12 feet would be insufficient. It is therefore unadvisable to diminish the proposed surface width of 16 feet.

It was intended to construct the weir after the manner of that at Furens, the masonry courses being broken in all directions. The term *coursed-rubble* indicates that the work will be constructed with the largest self-bedded stone procurable, and not with small irregular stones, which cannot be dressed, as is usual, in uncoursed or random rubble.

The embankment on the right bank follows the road from Bhetre, and taps a range of hills from which rubble stone could be obtained. It was therefore designed with a top width of 20 feet, in order that it might be used for traffic. A similar reason fixed the width of the bank on the left from the weir to Pareecha, and on to the metalled road. As the Customs hedge divides the bank from the road above this point, it would be a boon to the cultivating community to make the bank of sufficient width for carts to pass along, and the possible saving to be effected is quite unimportant.

The number of bridges is determined by the probable wants of the country when irrigation is developed. The experience of the Ganges Doab has led to the establishment of a scale according to which the intervals between bridges diminishes as the bed width of the channels and consequent cost of structures becomes less. The same scale is applied to the Betwa project, for the same requirements will arise, as the population bordering that canal increases. The bridges are occupation-bridges, required for communication between the severed lands of an estate; it is provided in the report of the estimates that they would only be built as required: the accuracy of the estimates, as financial indicators, will be vitiated if due provision is not made for bridges. Rafts and ferries are impossible in these small channels which would be choked by them; and would in this situation be more costly than bridges: for a ferry requires a man in charge, besides constant repairs if there is anything temporary in its character. If it is a pontoon raft, plying between metalled approaches, it only pays where the channel is wide and bridges costly. It was contemplated that foot-bridges may be substituted in most cases, but our knowledge of the country is not sufficient to determine whether this is the case, or to what extent. The Chief Engineer is unwilling to alter this part of the estimate.

The falls are designed in the manner habitual in the North-Western Provinces, with a length of crest equal to the mean width of the channel.

It is but just now that the Government of India has succeeded in introducing a system of complete and accurate estimate which includes all probable charges; and there cannot but be risk of retrogression in this important matter if a Chief Engineer is required to make a complete estimate for one scheme, and a less complete estimate for another.

There is no safety save in the hard-and-fast line of completeness; and I submit, with every respect for the professional advisers of the Government of India, that the proper course is that estimates for all works without exception should include all probable charges.

E. A. S.

AUSTRALIAN COAL.—Australian coal has been recognised in India, Africa, China, and some of the coaling stations, used by both the mercantile marine as well as the navies of various countries in the Pacific, patronise Australian coal. It has had a slight demand on the Western Pacific coast of America; but recently the demand had so greatly increased as to cause very great activity in Newcastle, New South Wales. Several large sailing vessels and one or two steam colliers are loading for San Francisco. So it is evident the Americans have learned to appreciate Australian coal, and when it is considered there is a tariff on coal imported into America, this demand is to be further appreciated. It is a long sea voyage from New South Wales to San Francisco, but it has the advantage of being through a semi-tropical belt, where the times of storms, &c., can be steadily calculated. This route is used by several visitors to and from England to the Colonies.

AN IMPROVED CAST-IRON SLEEPER.

BY G. E. MOORE, M. INST. C.E.,

Deputy Consulting Engineer to the Government of India for Guaranteed Railways, Calcutta.

THE drawings shew designs for a cast-iron sleeper with a tie-bar connection.

My experience is that steel sleepers are not suited for India, especially the damp climate of Bengal, where they rapidly corrode on the seat under the rail, and are then useless even as scrap, cast-iron being the most suitable. The drawback against using cast-iron sleepers hitherto has been the great number of parts and high initial cost. Several lines still stick to pots, which I consider a bad form of sleeper, as it is impossible to pack pots, so that the whole area does equal service, resulting in heavy renewals.

The chief defects of all pot and plate sleepers now in use are—

- (a) Inaccuracy of gauge.
- (b) Great number of parts.
- (c) Height of rail above tie.
- (d) Difficulty of laying and taking out of road.

These defects I have attempted to remedy.

Fig I.—Is a plate sleeper for the 5' 6" gauge double-headed rail with a T-iron tie-bar. The operation of laying is quite simple, the plates being inserted under the rails, the tie-bar is put into plate and the cottar driven home.

The gauge depends upon the accuracy of length of the tie-bar, and not, as in other sleepers, on the accuracy of the castings.

Fig II.—Is the same sleeper suited for a flat-footed rail.

Fig III.—Is a plate sleeper for the metre gauge of the simplest construction.

Fig IV.—Also for the metre gauge, is a stronger and stiffer form.

Fig V.—For metre gauge does away with all small parts. The sleeper consists of only two plates and a tie-bar.

To lay it—the plates must first be put as shewn in dotted lines, and the tie-bar inserted into the socket cast on to the end of each plate, and then the plates must be gradually shifted till they are in their right position, square to each other, when the tie-bar, which is notched near each end, will pass over a corresponding lug cast on the plate which gives the gauge. Here the gauge depends on the perfection of the casting, but as the crucial measurement is only about 5 inches apart on the same plane, it should not be difficult to obtain accuracy enough for all practical purposes.

The advantages claimed for these designs are—

- 1st.—Few parts—3 to 5 only.
- 2nd.—*Cheapness.*—Owing to few parts and to rail being directly on the plate less metal is used. It is easily cast, one pattern only being required; a saving also is effected in the tie-bar.
- 3rd.—*Long life.*—Being of simple and strong form, all iron. Having the tie-bar above the plate instead of being buried in the ballast, it will not rust into the socket.
- 4th.—*Accuracy of gauge.*—Each tie-bar is a gauge rod, and when driven up to the rail with the tapered cottar, the accuracy of the gauge is ensured. The tie-bar being above the ballast is not so liable to be bent, and as the tie is situated just under the upper table of the rail, any bending of it will not affect the gauge to anything like the same extent as in other systems where it is fixed below the rail.
- 5th.—*Steadiness.*—Owing to the position of the rail directly on the plate, the road will be much steadier than in other systems where the rail is fixed at a considerable height above the level of the bottom of the sleeper, besides being much easier to maintain.
- 6th.—*Ease and celerity* with which it can be put in and taken out of the road.

Owing to the position of the tie-bar and the mode of

fastening, the fastenings are open to inspection and any part of the sleeper can be renewed without disturbing the rest of the road or removal of ballast.

No provision has been made for alteration of gauge on curves, as I do not consider that for standard curves in ordinary country any is necessary.

G. E. M.

PROPERTIES OF FLUIDS.

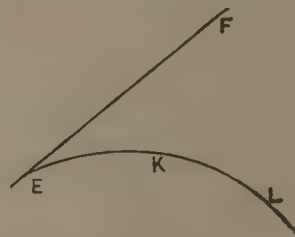
BY A. EW BANK.

XVI.

IN every rigid body, small or large, simple or complex, there is one peculiar point called the centre of gravity, sometimes it is called the centre of inertia. Let us denote it by G. To illustrate the peculiarities or the characteristic properties of this point, let our body be a mass of iron, lead, stone or wood, or any other tolerably rigid body. On its external surface take anywhere a point A. At this point attach to the mass a small ring. To this ring fasten a string A B. Let B be a ring in the roof of a building, or let B be any other practically immoveable point. Let the mass be suspended in the air by the string A B. Then the three points B, A, G, will lie in one straight line. It is this peculiarity of the point G that is generally thought of when G is called the centre of gravity.

While the mass hangs at rest, let us choose anywhere on the surface another point C. Imagine the line G C to be drawn and to be produced out from the body to any point H. With a hammer, or by any other means, let a blow be delivered on the body. Let the line of action of the blow be strictly the line H C. At the moment the blow is delivered let the string A B be cut. Thus the body is free to accept any movement which may jointly be due to the effect of the blow and the weight of the body—which weight will immediately begin to act under the influence of the blow and of the weight, the body will soon have described a small portion of some curved line. To make this statement more precise, we say that the point G of the body will have described a certain portion of a certain curved line. This curved line is indicated by *fig. 56*.

Fig 56



E F is a line drawn from the initial position of G and drawn in the direction H C G produced. Thus H C G F is one straight line and the points G, E are initially coincident. E, however, is a fixed point of space, while G is a fixed point of the body. G travels in space along the curve E K L starting from the point E.

Now, not only does the point G of the body start along this curved line E K L, but the point A of the body starts along a precisely similar curved line P Q R. P and A are initially coincident, and when G arrives at any point K, then has A arrived at a point Q, such that the curved line E K is equal to the curved line P Q. Similarly, B starts on another but a similar curved line. Let this curved line be called X Y Z. Then X means the initial position of the point B of the body. When G has reached K and A has reached Q, then B has reached Y and the arc X Y = arc P Q = arc E K.

All other points of the body, whether they are on the surface or inside the body, move on similar and equal paths.

In this discussion we are omitting from consideration any effect due to the resistance of the air. If we do

IMPROVED CAST IRON SLEEPER.

By G. E. MOORE, M. INST., C. E.

Fig. 1.

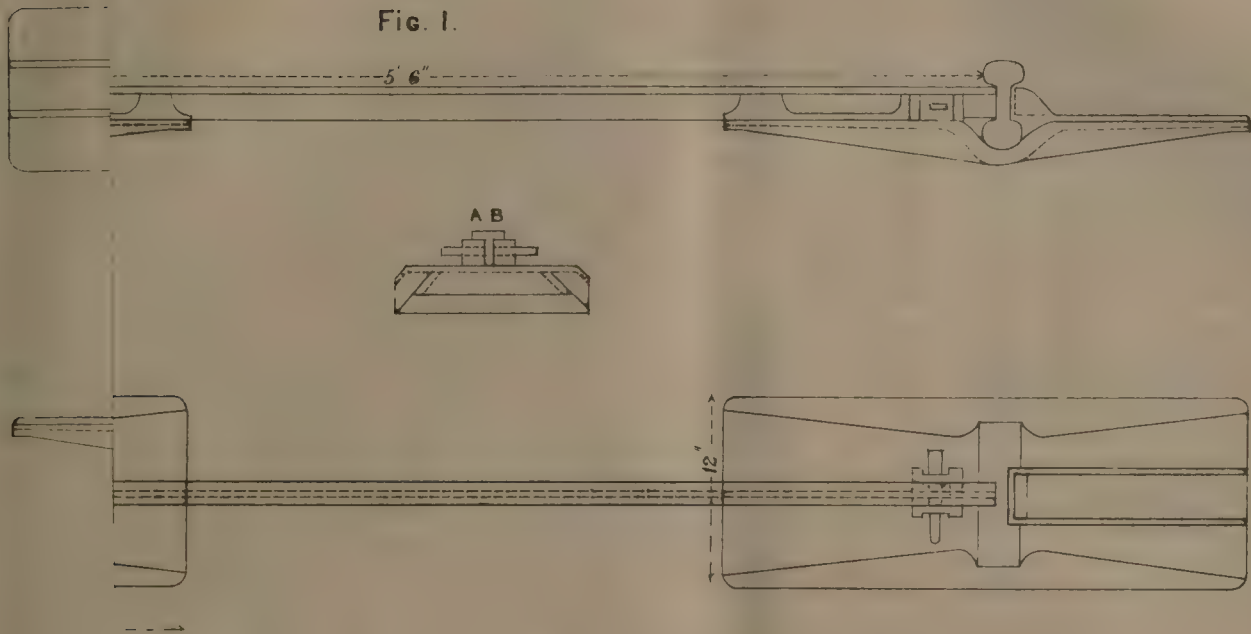
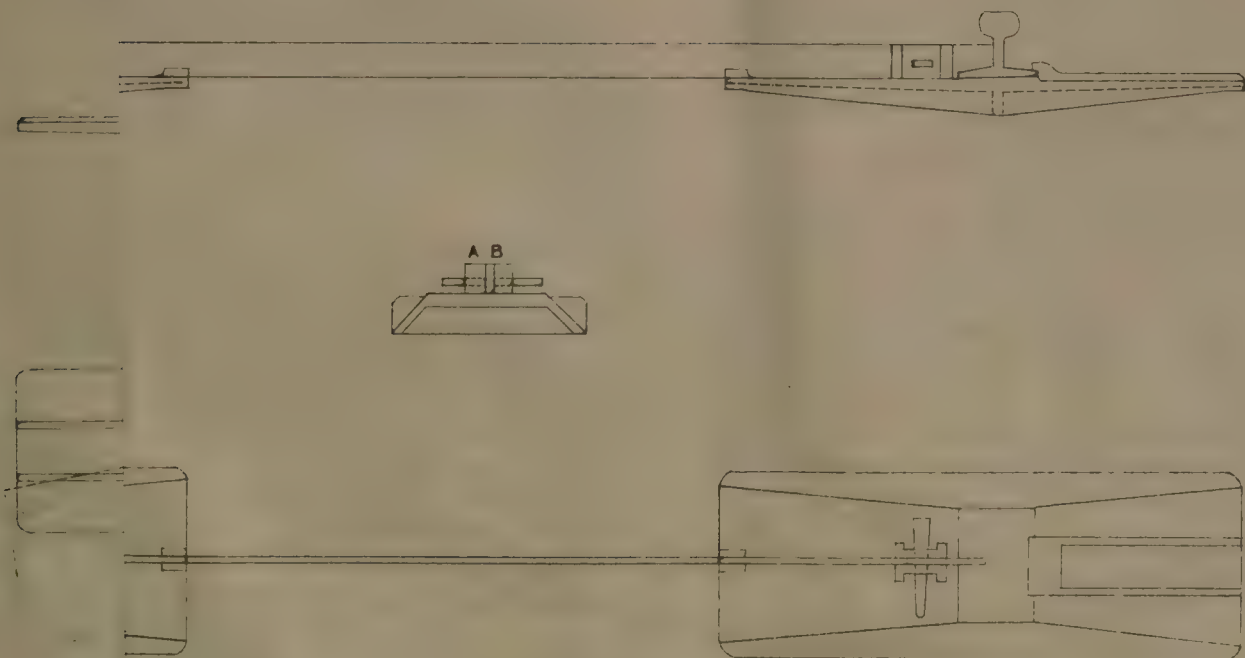


Fig. 2.



omit air resistances, and if we do consider—as we are justified in doing—the weight of the body as some one force acting through G, then we have all points of the body endowed at any one instant of time with parallel and equal velocities. Any one point of the body changes its velocity, but every other point of the body does simultaneously change its velocity. Moreover, these changes of velocity are all equal.

When we think of this tendency of a body to receive equal and parallel velocities for all its particles under the influence of a blow whose line of action passes through G, we call this point the centre of inertia. A more careful inquiry would shew us that the property we have described as appertaining to the centre of gravity is akin to that which we have just described as appertaining to the centre of inertia. But at present we may consider them as separate and independent properties. If we are asked to prove them, we may appeal to experiment.

When a body so moves that all points have parallel and equal velocities at any, the same instant of time, we say that the body has a movement of pure translation. We mean that the body has no movement of rotation. If instead of carefully arranging that the line of action of the blow shall pass through the particular point G, we deliver a blow at random, we shall generally see that the body not only starts forward under the influence of the blow, but begins simultaneously to spin. Instead of suspending a body by a string let us float it upon water. Then a blow delivered at random will generally make the body move forward *and turn*. A blow is merely a particular case of force. If on a floating body we make some force to act, choosing our force horizontal, but in other respects taking it at random, we shall induce a forward motion, which generally will be accompanied with a turning motion. Thus a ship sailing on an even keel has a turning tendency which we described as a dipping tendency. If a ship instead of having her sails above the deck had them spread out on one side—like one wing of a bird or like an oar of a boat—the influence of the wind on the system of sails would not only be to urge the ship forward, but also to make the ship turn or change the direction of her bows. When a ship having her sails arranged above the deck heels over for any reason, then the line of action of the wind force is not only higher than the centre of gravity of the ship, but it is also sideways. In this case there is a tendency to dip the bows and also to change the course. The dipping tendency is a tendency to rotate about some horizontal axis. The veering-round or change-of-course tendency is a tendency to rotate about some vertical axis.

Thus each of these rotations is an example of the same dynamical principle, *viz.*, that if a force is to induce a motion of translation, but not to induce any motion of rotation, then the line of action of the force must pass through a particular point of the ship called its centre of gravity or its centre of inertia. But though the dipping tendency and the change-of-course tendency are similar dynamical effects, yet they are very different when considered by the captain or by the builder of a ship. For when a ship dips, the water pressures resist the dipping and endeavour to restore the original position. On the other hand, when a ship has had her head moved round, the water pressures do not in any way tend to restore the old direction in which the ship was looking. In order to restore this old direction the rudder is called into play. Thus the dipping tendency may be accepted by the captain, but he incessantly opposes the veering-round tendency by his orders to the man at the wheel.

ADVERTISING CHARGES. The following are said to be the advertising charges of three of the great American newspapers:—A column in the *Chicago Tribune* costs the advertiser £5,200 per annum. The *New York Herald* receives for the lowest price £7,300, and for the highest £12,600 per annum for a column. The *New York Tribune* for its lowest gets £4,250, and for its highest £17,000 for the same space. And these papers, it is said, never lack for advertisements to fill their columns.

NOTES FROM HOME.

(From our own Correspondent.)

THERE has been quite a plethora of Parliamentary returns dealing with trade matters issued during the last week or two, and not the least interesting is the document relating to the Railway accidents of last year. It shews that the number of passengers killed during 1887 from causes entirely beyond their own control—casualties to trains, rolling-stock and permanent-way—is very much larger than in 1886, and larger indeed than in several years past. There were as many as 25 fatalities caused by collision, while in the previous twelve months only 8 were recorded. At the same time the remarkable fact is brought out that all of those 25 passengers were killed on one line and in one disaster. But for the unfortunate collision at Hexthorpe sidings during the Doncaster Races of September last, the record of our gigantic Railway service would, in this respect, have been stainless.

A torpedo range at Horsea Island, Portsmouth, costing £100,000, has just been completed, and taken over by the Vernon Torpedo School. The range, some half mile in length, has been constructed for experimental purposes in connection with the discharge and flight of torpedos, and with its canal, lock, quays, wharves, tramways, firing-pier and offices form a prominent feature in the view of Portsmouth Harbour as seen from the surrounding heights.

Our 110-ton guns have already been surpassed by the Krupp 118-ton guns, which were supplied to the Italian Government a short time ago. With these guns a wrought-iron plate of 41 inches thickness can be penetrated near the muzzle, and 39 inches at a distance of 1,000 yards. They are made entirely of crucible steel, and are without trunnions, the connection with the carriage being made by means of ring projections. During experiments with these weapons, results were obtained which are stated to be the highest realized by any cannon. These achievements, however, are soon likely to be surpassed by the production of other monster weapons by Krupp of Essen, who, it is stated, are now constructing a 150-ton gun at these works. The great 120-ton gun was followed by the 140 ton gun, and this now by the 150. The present monster piece of artillery is stated to be similar in its construction to the 140-ton gun, but of greater length and possessing greater power of range. The 110-ton gun, which this firm built for the Italians, has been fired over 200 times, and is reported to be in a perfect state.

An invention connected with military ballooning has just been tested in Berlin. It consists in apparatus for producing the inflating gas on the spot when required, instead of storing it under pressure and transporting to the scene of action in iron pipes on the plans adopted by the English authorities. The generator is said to resemble a traction engine in appearance, and is drawn by six horses. In its lower portion is a furnace specially adapted for burning wood, and over this is ranged a series of iron retorts (thirty in number) which are filled with a mixture of zinc dust and hydrate of lime, which on heating gives off hydrogen; about two hours being required to obtain sufficient gas to inflate a military balloon. This system, which is the invention of Lieutenant Richter and Dr. Margert, is said to be cheaper, more rapid and less dangerous than all previous systems.

Instructions have been issued by the Admiralty for preparations to be made for building *The Blake*. She will be the largest, fastest and most powerful cruiser ever built for the Royal Navy. She is to have a displacement of 9,000 tons, and will be fitted with machinery of 20,000 horse-power, which is 8,000 in excess of the engines of the first-class ships *Nile* and *Trafalgar*. *The Blake* will be built of steel, and her metal parts will be protected by a steel deck extending the entire length of the ship. It is expected that she will be capable of steaming 22 knots per hour.

Professor Oliver Lodge has been giving some admirable lectures on lightning protection at the Society of Arts, and has pronounced the use of copper for such purpose as doomed. He argued that the supposed area of such protection was mythical, and that the true way to protect a building was by Maxwell's cage. He advocates iron, and shewed copper to possess "inertia" to such an extent as to render its use dangerous. He also found that, under certain circumstances, such as sudden violent discharges untempered by time points were of no use, but he suggested the use of barbed wire along the ridges and eaves of roofs.

The general arrangements for the Bath Meeting of the

British Association have now been made. The first meeting will be held on Wednesday, 5th September, when Sir H. Roscoe will resign the chair, and Sir F. J. Bramwell, President elect, will assume the Presidency and deliver an address. Among the papers set down to be read at the meeting is one on the electric transmission of power by Professor Ayrton.

The Association of Municipal Engineers are able to announce that during the twelve months just ended sixty-two new members have been added to its rôle. This number includes 10 Borough Surveyors, 2 City Engineers, 2 County Surveyors, 22 Surveyors to Local Boards, 5 Town Surveyors, 6 Metropolitan Surveyors, 1 Engineer to Corporation Gas Works, and 10 Graduates. These numbers, which exceed those of any previous year, testify to the growing appreciation of the usefulness of the Association's work.

The annual dinner of the Civil and Mechanical Engineers' Society has just been held under the chairmanship of Mr. Middleton, the President. A good muster of members was present. Great satisfaction was evinced at the announcement that Mr. Middleton, who has shewn such zeal in the interest of this very useful Society, has been elected to fill the President's chair for another twelve months.

MINING IN GREAT BRITAIN.

THE Chancellor of the Exchequer, in answer to a question in the House of Commons, said: "The Crown has an ancient prerogative right to all mines containing the precious metals, and this right was judicially recognised in a famous case (*The Queen v. the Earl of Northumberland*) which occurred in the reign of Queen Elizabeth. The original right of the Crown to mines containing the precious metals in the Colonies was governed entirely by the law of England; but the Crown has in most cases transferred the prerogative right to the Colonial Governments, who have thus acquired the power of making regulations in regard to the granting and working of these mines; but I do not know whether in any Colony the right to these mines has been surrendered to the freeholders."

Geology has made enormous progress since 1815, when it was recorded in the preface to Volume XXXII. of the *Transactions of the Society of Arts* that "under the class *chemistry* will be found an account of a most valuable mineralogical map of England and Wales, a labor of many years by Mr. William Smith, in which he has, with infinite care and accuracy, pointed out the situation of the different strata of coal, lime, iron, stone, and other mineral products." This map was published by Carey in 15 colored sheets, and was drawn to a scale of 5 inches to the mile.

An explosion occurred on 19th April at the St. Helen's Colliery in Cumberland. The colliery has two shafts and works the "Two-quarter" and "Main Band" coal seams, at depths of 78 fathoms and 119 fathoms, respectively. About 80 men and boys are employed in the upper seam, which is ventilated by a current of about 25,000 cubic feet of air per minute. Some 250 men and boys are employed in the Main Band, which is aired by about 50,000 cubic feet per minute. In this seam gas is given off somewhat freely in the leading places, but is soon exhausted. The winning or narrow places are consequently kept closely bratticed up to the face, whilst no brattice is required in wide workings or bords. The Main Band has the following section:—

Metal band coal, about 4 feet.

Band of shale, from 1 foot to 6 feet.

Cannel band coal, about 5 feet.

The main roads are driven in the cannel band, and the shale taken down, leaving the metal band for roof. Two levels have been driven from the shaft for about 900 yards, and two to the north about 150 yards to a downcast fault. About 80 yards from the shaft, in the south levels, two roads have been driven at right angles to the dip for a distance of 750 yards; they pass through a nip out beyond which two narrow bords had been driven to the rise for some distance. A blower of gas became ignited in one of these places (by means of a shot) setting the coal on fire. A large number of men were actively employed in building a stopping to enclose the burning blower, and in the evening a very serious explosion took place, and 28 men were killed or speedily died from their severe injuries. It appeared that in order to facilitate the building of the stopping that the air current had been reversed which

allowed the formation of an explosive mixture, until it was exploded. After several of the bodies had been recovered and as the fire could not be extinguished by other means, the management decided to flood the mine, and this is now being carried out.

Considerable attention is being directed to the successful manner in which the South Staffordshire Mines Drainage Commissioners are carrying out the drainage works under their control, and upon whose success depends the existence of many of the collieries in their district. It appears, however, that the Commissioners have had to appoint inspectors, at a heavy cost, to check the returns of the minerals wrought and upon which their rates are based: it is alleged that they have been defrauded at least 60 per cent., and that of the returns previously furnished at least 90 per cent. were fictitious.

A new safety means of igniting shots is being introduced. It consists of a tube of metal, closed at one end and containing sulphuric acid, enclosed in a glass globe embedded in a mixture of chlorate of potassium and sugar. It is fired by compression and employed to ignite shots in mines where safety lamps are used, and obviates the necessity of opening the lamp when shots are to be fired.

Some figures have been recently published as to the cost of working coal with "Mould's Patent Coal Getting Machine," recently introduced at Moss Field Colliery near Longton. The machine produced 65 per cent. of round coal and 35 per cent. of slack, at a cost of 1-8½s. per ton. With powder, the produce was 73 per cent. of round coal, and 27 per cent. of slack, at a cost of 1-7¼s. per ton. The experiments were made in the Holly Lane Coal seam under, as nearly as possible, identical conditions. If a charge was made for use of machine, etc., the extra cost of 1¼d. per ton might become 2¼d. or 3d. per ton.

Mr. Ives, at the Boston Meeting of the Institute of Mining Engineers (U. S.), read a paper on the construction of Geological Maps. The proposal was to construct a geological map in sheets, each of which would represent the various periods and formations of the crust of the earth. These could be removed one by one and would convey a clear knowledge of the solid geology of the district of the map.

The attention of operators in metals has been absorbed in the tremendous collapse in the price of tin. On 28th April the quotation for delivery was £166 per ton; on 30th April it was £110, on 1st May £95, and declined in the next few days to £79-10-0; it has however recovered to about £84. It is hoped that more regular and steady business will be resumed and that the price of £100 per ton (which existed before the inflation) will be restored.

Potts' Mining Register for 1888, recently published, is a useful book for Mining Engineers. It contains the first part of a treatise on "the theory and practice of mine ventilation," which has been received with general approval by those who are conversant on the question. Mr. W. Fairley says that it alone "is worth money." The present issue deals with the nature and principal properties of the gases found in mines in a manner which can be read to advantage by either workman or manager. The new Coal Mines Regulation is reproduced with notes shewing the mode in which the section of the Act of 1872 and other subsidiary Acts which are now repealed are revised by the Act of 1887, and designating those sections which came into operation on 1st January last. The volume is well illustrated and contains a valuable geological map of Great Britain, together with numerous smaller maps shewing the geological features of the various coalfields.

The North of England Institute of Mining Engineers has appointed a special Committee to experiment and report upon the value of the so-called flameless explosives, and contrivances for the prevention of flame in shot firing. There is no doubt that this Committee, which comprises some of the most eminent Mining Engineers, will present a report which will prove of the utmost value to Engineers in all parts of the world. It is expected that their experiments will be carried out on a practical scale, and as such, will satisfactorily dispose of the claims of the patentees of many "flameless explosives" and "flame preventing" appliances. It may be remarked that this Institute, founded in 1852, and incorporated by Royal Charter in 1876, is maintaining its position of the premier Mining Institution by its appointment of committees to consider the important questions of the day.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Mysore, June 9, 1888.

Mr. R. T. Scaldwell, Executive Engineer, is posted to the charge of the Bangalore Division (with which the Palace Division will be amalgamated) with effect from the date on which Mr. Inman, Executive Engineer, proceeds on privilege leave.

Madras, June 12, 1888.

The following postings are ordered :—

Major R. R. E. Drake-Brockman, R.E., Executive Engineer, 1st grade, to the charge of IV. Circle.—To join on return from furlough.

Mr. C. A. B. Target, Executive Engineer, 1st grade, to the new Periyar Division.—To join at the public expense on arrival from Burma.

The following transfers are ordered :—

Mr. C. J. Peters, Executive Engineer, 1st grade, from the North Arcot Division, to special duty for charge of the construction of the Ponniar and Gadilam bridges.—To join on relief by Mr. C. A. Smith.

Mr. C. A. Smith, Executive Engineer, 4th grade, temporary rank, from the office of the Chief Engineer for Irrigation, to the V Circle, for charge of the North Arcot Division.—To join on relief by Mr. J. P. Davidson.

M. R. Ry. S. Gopala Krishna Aiyar Avergal, Rai Bahadur, B. C. E., Assistant Engineer, 1st grade, from the III. Circle, Kurnool Division, to the VI. Circle, Madura Division. To join from privilege leave.

Mr. G. F. Handcock, Assistant Engineer, 1st grade, from the I Circle, Rushikulya Division, to the II. Circle, for duty in the Kistna Eastern Division.

Mr. T. W. S. Smyth, Assistant Engineer, 2nd grade, is granted furlough on medical certificate for three months with effect from 7th May 1888.

The following promotion is made :—

Honorary Lieutenant and Assistant Commissary J. A. Power, from Assistant Engineer, 3rd grade, supernumerary, to Assistant Engineer, 2nd grade, supernumerary, permanent. With effect from 18th May 1888.

Bombay, June 14, 1888.

Mr. A. E. Hight acted as Executive Engineer, Khandesh, from 1st to 22nd March 1888, both days inclusive.

His Excellency the Governor in Council is pleased to make the following temporary promotions in the Engineering Establishment, with effect from 3rd May 1888, *vice* Colonel C. A. Goodfellow, R.E. :—

Mr. J. E. Whiting, M.A., M. INST. C.E., to be Chief Engineer, 3rd class.

Colonel W. Merriman, R.E., to be Superintending Engineer, 1st class.

Colonel J. D. Cruickshank, R.E., to be Superintending Engineer, 2nd class.

The following temporary promotions should also be made :—

Lieutenant-Colonel E. D'O. Twemlow, R.E., to be Superintending Engineer, 2nd class, from 14th November 1887 to 6th February 1888.

Colonel W. Merriman, R.E., to be Superintending Engineer, 2nd class, from 7th February to 2nd May 1888.

Punjab, June 14, 1888.

Lieutenant H. C. I. Birdwood, R.E., Assistant Engineer 2nd grade, and Mr. E. E. Taylor, Assistant Engineer, 3rd grade, passed, on the 14th May 1888, the Departmental Standard Examination.

Hyderabad, June 15, 1888.

With reference to Government of India Public Works Department telegram dated the 16th instant, Mr. G. K. Watts, Assistant to Superintending Engineer and Assistant Secretary to Resident, Hyderabad Public Works Department, assumed charge of the office from Mr. H. F. White, Officiating Superintending Engineer and Secretary to Resident, Hyderabad, on the afternoon of the 26th idem.

Central Provinces, June 16, 1888.

In continuation of Notification dated 30th ultimo, Rao Sahib D. S. Sathaye, Executive Engineer, 4th grade, temporary rank, on return from privilege leave, is posted to the Nagpur Division.

With reference to Notification dated 31st ultimo, Mr. M. Leslie, Executive Engineer, 3rd grade, availed himself of the privilege leave granted to him, making over charge of the Kanhan Division to Mr. G. M. Harriot, Executive Engineer, 4th grade, temporary rank, on the afternoon of the 8th current.

With reference to Government of India, Public Works Department, Notification dated 13th March 1888, Lieutenant-Colonel E. N. Peters R.E., Executive Engineer, 1st grade, reported his arrival at Bombay on the 12th March 1888, and is posted to the Hoshangabad Division on special duty. Lieutenant-Colonel E. N. Peters joined the Division on the afternoon of the 18th March 1888.

With reference to Government of India, Public Works Department, Notification dated, 27th, April 1888, Mr. E. J. Rumsby, Executive Engineer, 3rd grade, made over charge of the Hoshang-

gabad Division to Lieutenant-Colonel Peters, R.E., Executive Engineer, 1st grade, on the afternoon of the 5th April 1888. Mr. E. J. Rumsby availing himself of the two years' special leave granted him, *vide* Government of India Notification dated 27th April 1888, with the usual subsidiary leave, with effect from the 6th April 1888.

With reference to Public Works Department Notification dated 15th June 1888, Mr. E. J. Rumsby, Executive Engineer, reported his departure from Bombay on the 13th April 1888.

N.-W. P. and Oudh, June 16, 1888.

Irrigation Branch.

Mr. W. A. Francken, Executive Engineer, 3rd grade, Nadrai Aqueduct Division, Lower Ganges Canal, is granted furlough for five months, under Chapter V, Section 50 (1), of the Civil Leave Code, 6th edition, with effect from the 1st July, 1888, or subsequent date.

Buildings and Roads Branch.

Under the orders of the Government of India, Public Works Department, Colonel J. G. Forbes, R.E., and Mr. T. H. Wickes respectively made over and assumed charge of the office of Chief Engineer, Buildings and Roads Branch, and Joint Secretary to Government in the Public Works Department, on the forenoon of the 9th June 1888.

India, June 16, 1888.

Mr. D. Joscelyne, Executive Engineer, 2nd grade, Rajputana, is transferred to Burma.

Mr. W. G. Gilchrist, Executive Engineer, 2nd grade, attached to the South Indian Railway, is granted ten months' furlough to Europe, with the usual subsidiary leave.

With reference to Home Department Notification dated the 8th June 1888, the services of Mr. H. L. Tilly, Assistant Engineer, 1st grade, Burma, are placed permanently at the disposal of that Department.

Bengal, June 20, 1888.

Establishment.

Mr. J. C. G. Keddie, District Engineer, Gya, is granted privilege leave for three months with effect from the 1st July next, or such subsequent date as he may avail himself of it.

That part of Notification of 1st ultimo, promoting Mr. H. H. Green, Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary, from the 14th March last, is hereby cancelled.

Mr. M. H. Jackson, Assistant Engineer, is transferred from the First to the Second Calcutta Division, which he joined on the afternoon of the 8th instant.

Establishment.

Mr. J. T. Boase, Executive Engineer, is, as a temporary measure attached to the office of the Superintending Engineer of the South-Western Circle from the afternoon of the 14th instant.

Mr. J. P. Cleghorn, Executive Engineer, is transferred from the office of the Superintending Engineer of the Eastern Circle to the Orissa Circle.

Mr. Cecil Taylor, Executive Engineer, is transferred from the Orissa to the South-Western Circle.

Mr. J. T. Boase, Executive Engineer, is transferred from the office of the Superintending Engineer of the South-Western Circle to the Orissa Circle.

Mr. G. C. Stawell, Assistant Engineer, is transferred from the Orissa to the Sone Circle.

Establishment—Railway.

With reference to Notification of the 18th February 1888, the services of Mr. J. T. Boase, Executive Engineer, are replaced at the disposal of the Provincial Branch.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 11th June, 1888.

94 of '87.—Rai Bahadur Thakur Das, of Pind Dadun Khan, Assistant Surgeon, Ferozepore, Punjab.—*For a double sugarcane crushing machine.*

27 of '88.—Robert Rickie, Madras Presidency, Mechanical Engineer.—*For securing removable gudgeon pins in the cross heads and connecting rods of locomotive or other engines.*

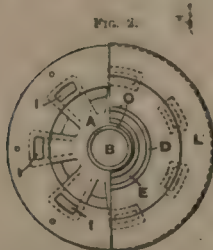
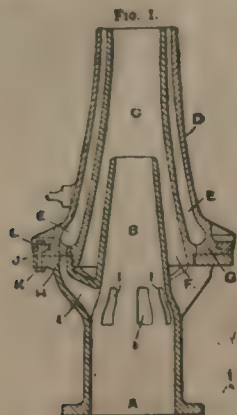
35 of '88.—Robert Southworth Lawrence, Gentleman, of No. 871, Preston Street, Philadelphia, Pennsylvania, in the United States of America, temporarily residing at the Hotel Victoria, Northumberland Avenue, London, England.—*For improvements in carburetors or apparatus for enriching or producing gas.*

39 of '88.—Charles John Geneste, Managing Director, and Thomas Akitt, Resident Analytical Chemist of the Indigo Company, Limited, both at present residing at Begum Serai Indigo Factory, Monghyr.—*For increasing the yield of Indigo from the Indigofera by the use of Boric Acid in the process of manufacture.*

93 of '88.—Heinrich Bruns, of Niendorf, in the Kingdom of Prussia, Engineer.—*For an improved device for cleaning or trimming cylindrical burner wicks.*

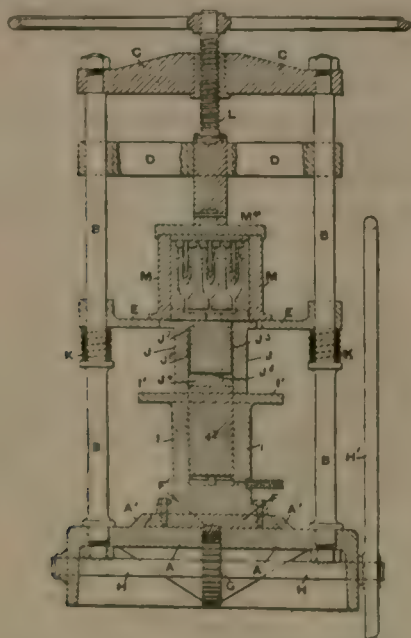
RECENT BRITISH PATENT.

BLAST PIPES FOR LOCOMOTIVES.—*H. Appleby & J. G. Robinson, Limerick.*—The parts of this apparatus are arranged in such a manner as will allow the blast to be varied at will. The improved blast pipe A consists of a central steam nozzle B, which communicates with the exhaust of the motor cylinders. The air passage C and second steam



passage F surround the nozzle B. The openings F for the intake of air are placed at or about the level of the lower row of boiler tubes. The casing D is retained in its place by the flange G and ring J, which allow D to rotate partially over the lower part of the apparatus. The cap L revolves with the upper casing in order to exclude the ashes from its working face. The ports H correspond with passages I, and lead from the central nozzle B to the outer steam passage E. When these two sets of ports register with each other, the steam is free to escape by the annular orifice; but upon the external casing being partially rotated, the supply of steam to E is more or less intercepted, with the effect of increasing the draught. Six claims are made for this method of regulating the draught by means of the rotatable casing.—No. 6784. May 9th, 1887.

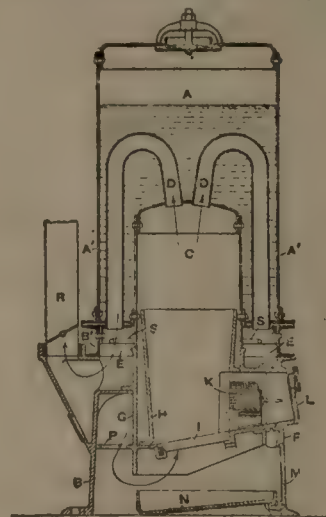
CASTING METALS UNDER PRESSURE.—*J. J. C. Smith, Passaic, New Jersey, U. S. A.*—Several improvements are here introduced into the construction of an apparatus described in patent No. 1,443 of 1869 granted to B. J. B. Mills. The general arrangement is shown in cross section in the accompanying diagram. The supports B carry the cross bar C, and form guides for the plates D and C. The hydraulic cylinder I is bolted to the sliding table F, which is movable sideways by means of the rack F', pinion G, and hand wheel H'. The plunger I' projects above the top of the cylinder I, and it is surmounted by a layer of clay J'. The cylinder J is made in two halves, which are hinged to I on one side, and bolted together on the



other. An asbestos lining J' prevents the heat of the molten metal in J from escaping through the walls, and a washer J' serves a similar purpose. The cylinder M is fastened to the plate E in the same

manner as I, and is also made in two movable halves. The moulds are contained inside the cylinder M; those in the drawing are intended for the casting of elongated projectiles. In operating the machine the screw L is raised together with the table E and the mould receptacle M. This movement enables the slide F to be moved out of its central position, carrying the cylinders I and J along with it. After the molten metal has been deposited in J, the table F is replaced in its normal position. The screw L is then depressed, so as to form a tight connection between the receptacle J and the flask M. The valve admits the water underneath the plunger I' after the moulds are in position, and the metal is forced up into the moulds. After the casting is completed the top M' is unscrewed, and the flask M is separated into its two parts to facilitate the removal of the castings. Nine claims are made for the construction of the flask M and the cylinder J, for the interior lining employed, and for the disposition of the vessel J.—No. 9322. 30th June 1887.

STEAM BOILERS.—*A. J. Boulton, London. (A. Stehlik Vienna.)*—The accompanying figure shews a vertical section of the boiler with its furnace and foundation. The boiler consists of two parts—the inner and lower part B', with the fire box C and flues D, and the outer shell A', which can be easily detached from the inner part. The boiler is mounted on a circular foundation B, which consists of outer wall F, furnace G, fire grate I, and refractory wall H. The movable block K serves to regulate the combustibles on the fire grate. The ash pit N



can be reached through the door M, and is filled with water for the purpose of preventing the melting of the fire bars. The bottom of the boiler forms with the outer wall F and the furnace G a circular smoke box, into which the return flues D open. A circular air chamber P is formed round the furnace, and the air enters through an opening in it. The air is highly heated in this chamber before it passes into the grate. The return flues may be cleaned by means of a jet of steam from the tube S. The arrows indicate the course of the draught. The inventor claims the construction in two parts, and the combination of the return flues D with the smoke box E, air heating chamber P, and movable block K.—No. 1824. February 7th, 1888.

Advertisements.

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AN EXPERIENCED ESTIMATOR.

Apply with copies of testimonials and stating salary required, to—

THE STATE ENGINEER,
Bhavnagar.

NOTICE.

TENDERS for the carriage of building materials from Akra to Calcutta, for the year ending 31st August 1889, will be opened by the Superintendent of Works, Calcutta, at his office at 12 noon on Saturday the 7th July.

Form of tender and any further information may be obtained at the Office of Superintendent of Works.

G. F. E. S. NEILL, LIEUT.-COL., M. S. C.,

Superintendent of Works, Calcutta.
(145)

CALCUTTA; the 20th June 1888.

WANTED a Draftsman, who also possesses a thorough knowledge of estimating, for the Office of the Executive Engineer, Pooree Division at Cuttack. Salary Rs. 45 per mensem rising to Rs. 50.

Apply with copies of testimonials, to the EXECUTIVE ENGINEER.
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Extracts from the Twenty-sixth Annual Report viz. for the year 1887.

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Re-insurances ...	£769,265 0 0
Interest ...	£ 19,612 0 0
Losses after deducting Re-insurances ..	£443,587 0 0

LIFE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£125,559 0 0
Interest and Dividends ...	£ 45,649 0 0
Claims less Re-insurances, £	79,229 0 0

MARINE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£175,118 0 0
Interest ...	£ 8,294 0 0
Losses after deducting Re-insurances ..	£138,365 0 0
Interest not belonging to above, but included in Profit and Loss ..	£ 18,545 0 0

The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording absolute security to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

C. H. OGBOURNE, *Manager and Underwriter.*

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Glasgow Coats Iron and Steel Company's Steel and Iron Angles and Tees. Flat, Round and Square bars "Coats Best." No. 1 Dynamite Rs. 1 6 per lb. No. 1 Blasting Gelatine Rs. 1 12 per lb. Treble Dynamite Detonators " 2 10 per 100 Gelatine Detonators " 2 14 per 100

(44)

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CREAT WESTERN HOTEL,

BOMBAY.

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L YING at Rajmai Tea Estate, Sibsagar, Assam, a new double gear Drilling Machine, 2 1/2" Steel Spindle complete.

A set of 22 Morse Twist Drills 1/2 to 1 1/2. A set of 22 Common Twist Steel Drills. Cone for four speeds, also hand action.

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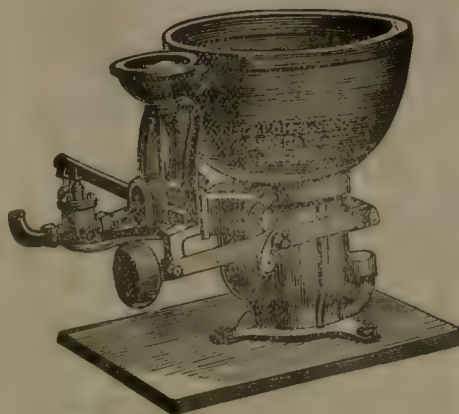
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CHITTAGONG :
The 1st June 1888.

* "The tender will be opened on Monday the 9th July 1888 and not 4th July 1888"

(138)

F. SILLS, C. E.,
EXECUTIVE ENGINEER,
Chittagong Division.

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16th June 1888.

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General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

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As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

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INDIAN ENGINEERING.

SATURDAY, JUNE 30, 1888.

THE GOVERNMENT OF INDIA P. W. D. RESOLUTION NO. 613G., DATED THE 14TH MARCH 1888.

OUR attention has been drawn to the fact that by the terms of a recent Resolution of the Government of India in the P. W. D. a number of Civil Engineers in the Department are placed at a disadvantage compared with Royal Engineer officers employed in the same Department.

The "Resolution" was referred to by us in our issues of the 26th May and the 9th June, and given *in extenso* in our issue of the 28th April last. It states that the Government of India, after considering the present system of grading of Subalterns of Royal Engineers on their first appointment to the P. W. D. with Civil Engineers, has arrived at the conclusion that these Royal Engineer officers are placed at a disadvantage in comparison with the Engineers appointed from the Royal Indian Engineering College at Cooper's Hill, who count service in the Department from the date on which they leave College to go through a course of practical training either in England or India. On this conclusion His Excellency the Governor-General in Council is pleased to rule, with the concurrence of the Secretary of State, that Subalterns of Royal Engineers appointed to the Department subsequent to the year 1872, when Engineers from the R. I. E. College first entered the Department, shall count extra service in the Department, which is limited in amount to one year.

Now, this rule quite ignores the fact that, previous to 1878, no Engineers appointed to the Department from Cooper's Hill counted any service for the time during which they were undergoing a course of practical training; for under the system in force during that period, the passed students of the College were only appointed Assistant Engineers in the Department after they had completed this course. It seems to us, therefore, that in attempting to do justice to Royal Engineer officers who entered the Department subsequent to 1877, an undue advantage has been conferred on Royal Engineer officers who entered between 1872 and 1878, and an injustice done to Cooper's Hill Engineers who entered during the same period.

We can only conclude that this wrong is unintentional, and hope that His Excellency the Governor-General in Council will cancel the new rule and substitute a revised one, which, in order to do justice to all, should at least allow the men appointed from the R. I. C. E. College previously to the year 1878 to count as departmental service the time they spent on their practical training.

It is desired in the highest official circles at St. Petersburg that England should continue her Indian North-Western Railway system as far as Herat. The Russian Government would then also push the railway on to Herat from Merv.

TIDAL OPERATIONS IN INDIA.

I.

FOR many years observations of a more or less rough description have been taken from time to time at various places on the coasts of India with the object either of determining a datum for Marine charts, or of giving a basis for the determination of the heights of the various series of triangulation of the Survey Department, or of the heights of the bench-marks of the Irrigation or Railway Departments. In most cases these observations were made by setting up a tide-pole in a convenient spot and measuring the heights of high and low water during a period rarely exceeding one or two months.

A self-registering tide-gauge was first used in India in 1855 when it was set up at Karachi to determine the mean level of the sea as a basis for the heights of the Great Indus Series of Triangulation of the Survey of India. It was a small instrument and indicated variations of the level of the water to the one-hundredth part of a foot. These particular observations only extended for a month; but afterward Messrs. Parkes and Price carried them on at Karachi almost continuously and constructed tide-tables for that port. Self-registering tide-gauges were also used, for the purposes mentioned in the first paragraph at Tuticorin in 1871-72; at Aden in 1876-77; and at various places on the Hooghly.

The present system of observations cannot however be said to be a development of these crude and isolated attempts to determine the mean level of the sea; its origin is quite distinct.

On the 18th August 1866, an article appeared in the *Bombay Saturday Review* in which there were two distinct points at issue:—*first*, the illustration and discussion of the encroachments of land on sea or of sea on land, as evidenced especially by the Gulf of Cambay, and the coast of Kattiawar, and *secondly*, the illustration and discussion of the alternate rising and sinking of land as evidenced by the Runn of Cutch.

The attention of the Government of Bombay was drawn to this article, and after some correspondence with the Superintendent of the Geological Survey of India, it was decided to have a survey of, and soundings taken on, the coast of Cambay, and also to have a course of accurate tidal observations taken in the Gulf of Cutch.

At first it was proposed that the mean level of the sea in the scientific acceptation of the phrase, should be determined by observations extending over two lunations, and that the heights should be referred to permanent bench-marks close to high-water mark, and connected with the nearest principal stations of the Great Trigonometrical Survey, and also that the observations should be repeated after a lapse of 10 years. However, Lieutenant-Colonel J. T. Walker, R.E., the Superintendent of the Great Trigonometrical Survey, pointed out that the scientific meaning of the term 'mean level of the sea' is not the mean of all the high and low waters, but the mean of all the heights recorded for as long a period as possible at short and equal intervals of time. He also gave his opinion that the observations should be extended over a much longer period,

and that the bench-marks should be connected by spirit-levelling, in order to detect variations of height which were known to be not more than a foot or two in a century; he further considered that the observations should be made with self-registering tide-gauges capable of recording variations of height of $\frac{1}{100}$ th inch. These ideas were accepted and suitable self-registering tide-gauges obtained, from Adie of London, but the financial difficulties of 1869-70 postponed the commencement of the operations. However, the delay was fortunate, as it led to the work being undertaken in a much more thorough and accurate manner than was originally contemplated.

While in England in 1871, Colonel Walker ascertained that a committee of the British Association—presided over by Sir Wm. Thomson—had initiated a system of tidal investigations which was anticipated to secure scientific results of the highest value. In the general report of the operations of the Great Trigonometrical Survey for 1872-73, Walker remarks on the subject that:—"On studying the details of the operations I found that my original programme, which contemplated tidal operations of only a few weeks' duration, would be inadequate to detect the existence of minute secular changes in the relations of land and sea, and that no conclusive results could be obtained unless the observations were carried over a year at the commencement, and a corresponding period at the close of the term of investigation. I further saw that, if this was done, the value of the operations would be greatly increased, for the results would not only serve the purpose for which they were originally contemplated, but would materially contribute towards the attainment of the better knowledge of the laws of the tides, which is considered by the British Association to be so important a desideratum, and which is expected to lead to an evolution of the mass of the moon; to definite information regarding the rigidity of the earth; to an approximation of the depth of the sea from the observed velocities of the tide waves; to the retardation of the earth's velocity due to tidal friction, and also to the various practical benefits which must accrue from accurate predictions of the height of the tide at any given time." He further remarks that:—"It is well known that the rise and fall of tides on a line of coast is materially influenced by the direction and force of the winds, and that it also varies inversely with changes in the barometric pressure. Thus no tidal registrations can be deemed complete without simultaneous registrations of the condition of the atmosphere."

It happened that Lieutenant Baird, R.E., was in England at this time, and he was deputed to study the practical details of the method of tidal registration and of the harmonic analysis of the observations recommended and practised by the Tidal Committee of the British Association; on his return to India he was placed in charge of the operations, and selected Okha Point and Nowanar or opposite sides of the Gulf of Cutch and Hunstal at the head of the Gulf as the stations at which to set up the instruments.

The regular tidal registrations were commenced at Okha in December 1873, at Hunstal in March 1874, and

at Nowanar in April 1874. They were continued at Okha for 16½ months, at Hanstal for 14 months, and at Nowanar for 2 months in 1874, and 2 months in 1875. This long break at Nowanar was due to the rapid shallowing of the foreshore, but as the station lies nearly midway up the gulf, the observations at Okha and Hanstal were successfully used in conjunction with those at Nowanar to determine the mean sea level at the latter station. Thus the first series of operations to determine whether the relations of land and sea are constant or changing was accomplished.

(To be continued.)

THE INDIAN MINTS.

WE have before us a running comment by the Secretary to the Government of India in the Finance and Commerce Department on the working of the Calcutta and Bombay Mints and Assay Offices for the year 1886-87. There does not seem to have been much working. No gold was coined at either Mint. Only 462 lakhs of silver were coined, as against 1,029 lakhs in the previous year. Copper was coined to a considerable extent; some of it for foreign Governments—Ceylon, the Straits Settlements and the Portuguese Government. It is clear that the Mints had the merest pretence of legitimate work to do. What traditions of the elders, what charms of patronage, what claims of Dowry stand in the way of abolishing one at least of these supererogatory institutions. As things stand, a lot of public money is yearly wasted on the upkeep of necessarily costly establishments. We are told that expenditure on account of salaries and establishments in the two Mints during 1886-87 was less than that of the previous year by Rs. 44,490. And in the next paragraph the gilt is stripped from that mild gingerbread, by a statement that the diminished outlay is due mainly to the Calcutta Mint Master having been on furlough in 1886, to "the absence of the head Engraver," and to the fact that while for ten months in 1885-86 a large extra establishment was required for coinage of silver as well as copper, in the following year a similar establishment was only required for five months. There would appear to be no difficulty about securing establishments at the shortest notice—a fact that emphasizes the propriety of retrenchment and economy.

Apropos of Mint Accounts why should the cost of pension and furlough allowances be described as *pro forma* charges? Hard money or its equivalent is, we presume, paid to the pensioners. It strikes us that there is a deal too much *pro forma* in the working of Indian Mints. *Apropos* of that we note that sundry alterations in the machinery of the Calcutta Mint, designed to enable it to coin 3½ lakhs of rupees in a day of seven working hours, took no less than four years to complete. There seems to be a deal of pettifoggery too. For instance, we are told that the stock of gold in the Bombay Mint at the beginning of 1886-87 was increased from Rs. 4,602 to Rs. 4,632 by receipt of ten gold coins from the Royal Asiatic Society. We are not told what these gold coins were, to which a value of but Rs. 3 a piece was assigned.

No gold was tendered for coinage by the public. Much of the gold imported is absorbed by native States—to be hidden underground, we presume, or made into jewellery.

In Calcutta in 1886-87, silver to the value of Rs. 1,59,82,723 was tendered through the Currency Department for coinage, as against Rs. 4,83,23,963 in the previous year. So says the beginning of paragraph 5 of the Report before us; its conclusion suggests that good part of this was a transfer from Bombay. In short, the Report is very confused, muddled, and difficult to follow.

Here is a suggestive paragraph:—"For the Calcutta Mint nearly 15,000 maunds of copper slabs were purchased locally at an average rate of Rs. 23¼ a maund; this rate being less than that of the previous year by Rs. 2½ a maund. The Bombay Mint obtained its copper from England through the India Office, the cost averaging Rs. 22 per maund, against Rs. 24¾ per maund in 1885-86; but the Mint Master says that the slabs recently sent out are of rather inferior quality. It is a mistake, in short, to suppose that first-rate goods of any description can be bought in the world's markets at less than market value.

The expenditure on stores in Calcutta during 1886-87 was Rs. 65,780, against Rs. 86,792 in the previous year. This result is attributed to the smaller quantity of silver coined. Bombay expenditure fell from Rs. 2,38,603 to Rs. 70,282. The larger expenditure is accounted for by a necessity "for new lever presses and for fuel." Are we to suppose the latter necessity quite done away with?

With the decrease in the quantity of silver received for coinage during the year under review, there was, of course, corresponding decrease in the number of assays made. The average proportion of gold found in silver coins, at the Calcutta Mint, amounted to .283 per mille; in Bombay to .290 per mille. As to the procedure with regard to pyx trials of silver coins, we are told that from every lakh of rupees coined a certain number of pieces are taken at random, and that of these some are assayed singly, some melted and assayed together. The combined results give the average fineness for the lakh. To test the weight of the rupees, sample pieces are taken at random from every lakh struck, and weighed on an assay balance, coin by coin. In Bombay there were 367 pyx trials, and of the coins tested for weight only twelve were found past all remedy. Of these eight were above and four below the orthodox standard. But two lakhs of coin had to be readjusted for weight in consequence of two coins not being amenable to remedy—too heavy in one case, too light in another. The report says:—"The weight and fineness of individual coins vary much, though they are always well within the remedy allowed by law. In Calcutta last year the heaviest rupee was found to weigh 180.80 grains, the lightest 179.20. The greatest fineness of a single rupee was 918.6 per mille, the least 915.2."

FIBRE MACHINE COMPETITION IN PARIS.—The French Government has notified its intention of holding a competitive trial of machines and processes for the preparation of ramie and reha fibre. The competition will be held in Paris on the 15th of August next, and intending competitors should address "Le Conseiller d'Etat, Directeur de l'Agriculture, Paris."

Notes and Comments.

FIRST RAILWAY IN PERSIA.—The opening of the first Railway in Persia took place on the 21st instant. The line, which will be opened for traffic, extends from Teheran to Shahabdul, fifteen kilometres.

THE TOUNGOO-MANDALAY EXTENSION.—Colonel Jopp has returned to Calcutta after having "passed" 50 miles of the new line. He was precluded from going over the full length by the occurrence of floods, which played havoc with the "diversions."

P. W. D., CHITTAGONG DIVISION.—We have been favored with printed copies of the Executive Engineer's Specification for manufacturing bricks at Noakhalli, for distribution in connection with the advertisement appearing elsewhere in our columns.

THE TRAVANCORE RAILWAY.—The extension of the South Indian Railway into Travancore has at last been finally settled, and the work will probably be commenced at an early date. The line will run from Tinnevely *via* Shencottah and Quilon to Trivandrum.

GOOD NEWS.—We are glad to hear that Sir Asman Jah has determined that the interests of the Nizam's Railway shall in no wise suffer because of Abdul Huq's disgrace, which, says a Bombay contemporary, "does not necessarily mean the end of all things, Railway and otherwise."

CALCUTTA JUTE MILLS.—Anent the question as to what amount of working-capital is necessary for these concerns to keep them going, it is considered by those who have had practical experience of the business that it should not be less than Rs. 1,00,000 to Rs. 1,20,000 for every hundred looms.

PUNJAB PETROLEUM.—We notice in all the accounts of Mr. Noble's concession to prospect for mineral oil in the North-West corner of India, the omission of the fact that Mr. Noble gets a *grant-in-aid* of Rs. 20,000 from Government towards his exploration of the country, irrelative of the subjunctive advantages.

B. B. AND C. I. R.—The Directors of the Bombay, Baroda and Central India Railway recommend a dividend of 1s. 6d. per £100 of stock, in addition to the guaranteed interest due July next, making in all a distribution of £2 11s. 6d. per cent. for the half year, less English income tax, as against £2 18s. 6d. per cent. paid in July last.

THE ORDER OF ST. MICHAEL AND ST. GEORGE.—To be Companions:—Major C. E. Yate, C.S.I. for services on the Afghan Frontier Commission. Major W. Peacocke, R.F., for services on the Frontier Commission. Colonel J. H. Western, R.E., (Public Works Department, Egypt). Colonel Ross, R.E., (Public Works Department, Egypt).

INTENSE HEAT IN CALCUTTA.—The great heat continued up to Thursday last. It seemed lately to be more unbearable by both a water and ice scarcity. The decrease in the supply of water was caused by one of the pumps at Tallah breaking down before duplicate spare ones were ready for the work. The increased prices for ice were owing to the abnormal increase in the demand.

INSTITUTION OF CIVIL ENGINEERS.—The Council of this society has awarded a George Stephenson Medal and a Telford Premium to Sir Bradford Leslie, K.C.I.E., M. Inst. C.E., for "The Erection of the 'Jubilee' Bridge, carrying the East India Railway across the River Hooghly at Hooghly." Sir Bradford previously received Telford and Watt Medals and Telford Premiums.

THE CALCUTTA MINT.—It is very satisfactory to learn

from a Resolution in the Financial Department, that the suggestion of the Finance Committee, that the Calcutta Mint should be abolished, has been dropped; and, having regard to the future trade requirements of Eastern India and Burma, we think the decision arrived at is a very wise one, as experience will, no doubt, confirm.

THE PIONEER GOLD MINE OF KOLAR.—150 tons of ore were crushed at the Ooregum Gold Mine last month, and yielded 187 ounces of gold. This is the result of the first regular "clean up" at that part of the Kolar Gold Field on which mining operations were first commenced, and which, in spite of nearly nine years of discouragement, has been regarded by many experts as the most promising point of the locality.

THE LATE COLLISION BETWEEN THE S.S. "HEBE" AND "ARRATOON APCAR."—It is stated that the cost of repairing the damage sustained by the *A. Apcar* in the Straits of Malacca will exceed a lakh of rupees. The Naval Court of Enquiry has exonerated the officers and crew of the latter vessel from all blame. If the Admiralty upholds the decision a part of the damages will be recovered from the owners of the *Hebe* and the remainder from the underwriters.

SIR GEORGE BARCLAY BRUCE.—We have pleasure in announcing that Her Majesty has conferred the honor of knighthood upon Mr. G. B. Bruce, the President of the Institution of Civil Engineers. As a Railway Engineer, Mr. Bruce is well known in many parts of the world. In India he superintended the construction of a considerable part of the East Indian Railway, was Chief Engineer of the Madras Railway, and subsequently became Consulting Engineer for the South Indian Railway.

ASSURANCE.—An inventor wrote to *The Times of India* the other day begging that journal's assistance in the raising of two lakhs of rupees, needful for the development of a wonder working machine; the applicant has in his mind's eye to provide, until such time as the invention can pay its own way, "for the locomotion of the inventor, and to keep him in a state of comfort and respectability." Some men have brains, and some have cheek, as the Tichborne claimant would say, in such a case.

PROSPECTS OF THE BENGAL-NAGPUR RAILWAY.—The country through which this Railway traverses is said to be one of the richest districts in India. Great quantities of cotton and wheat can be grown between Raipur and Raighur, and the districts in the Mahanuddi would take from Calcutta piecegoods and salt, returning rice, wheat, timber, coal and other minerals. The districts and country served by the Bengal-Nagpur Railway are rich in minerals, but to what extent they can be profitably worked it is not possible to say.

AN ITEM FROM DEHRA.—The Nalapani water-supply scheme has at last been put in hand, much against the wishes of the non-official members of the Dehra Municipal Board. The natives were also against this scheme, because there is very little water in the nalas available for consumption in the town and station of Dehra. The water will scarcely meet the demand of the European population, not to speak of the natives. The work is being pushed on, under the contract of Mr. A. Campbell, the former Superintendent of the Roorkee Workshops.

PROPOSED RAILWAY EXTENSION IN BURMA.—We learn that Sir Charles Crosthwaite is strongly advocating the extension of Railways in Burma; he has proposed that a preliminary survey should be made from Sagaing on the

right bank of the Irrawaddy to Mogoung up the Ma and Meza valleys, a distance of about 360 miles, and for a branch line from Manlè to Bhamo, a distance of 80 miles. These lines when completed would hasten the pacification of the country and facilitate its administration. The line would also pass through rich country so as to make a Railway remunerative.

BURMA STATE RAILWAY.—The management of the traffic Department of the Burma State Railway does not appear to have a good reputation, as only one station-master out of eight that were ordered to join the Burma line from the Tirhoot State Railway will accept the transfer, the rest preferring to resign and forfeit their pensionable service than take employment in Burma on higher salaries. The management of the Locomotive Department of the Burma State Railway has been more fortunate, as it finds no difficulty in getting subordinates for the new extension to the open line.

SCIENTIFIC AND USEFUL.—Among the miscellaneous examinations of the Chemical Examiner, Madras, a few are noteworthy: (a) A white deposit upon clay from a supposed malarial mist which rises at Pottinghi (Vizagapatam district) after sunset was found to be an efflorescence of sodium sulphate. (b) A sample of magnesium sulphate manufactured from magnesite at Salem was found good. (c) A white soft silky substance brought down by rain in and for 6 or 7 miles around a village in the Godavari district was found to consist of animal and siliceous matter.

SIR CHARLES ELLIOTT AND "OURSELVES."—A correspondent writes:—"I notice your rival has succeeded in getting the Government of India to purchase 200 copies for one year and our Province is to be affiliated with 15 or 20 copies. I hope you have the same encouragement." *Discouragement* would more aptly describe the attitude of the Government of India towards this Journal. Its fair, fearless, and free policy does not find favor with a certain section of "officialdom." Nevertheless, we firmly believe in light and publicity, and will persist in the exercise of the right of open criticism.

THE SURVEY OF INDIA.—Sir Edward Buck, C.S., visited Dehra lately for the purpose of settling matters with the Survey Department, regarding the Survey buildings, which are eventually to be made over to the proposed Agricultural College. The head-quarters offices of the Trigonometrical Branch Survey of India are to be transferred from Dehra to Calcutta, and amalgamated with the Surveyor-General's Office there. This amalgamation of two large Offices will effect a reduction in the higher appointments of the establishment, and consequently retrenchment in the working expense of the Survey Department.

LOCOMOTIVE SUPERINTENDENTSHIP, BURMA STATE RAILWAYS.—The *Rangoon Times* says:—"It is rumored that Mr. Thomas, the Locomotive Superintendent of the Burma State Railways, who lately went on leave, when it was understood that on the expiry of his leave, was to be transferred to India, returns to Burma to resume charge from Mr. Dudgeon; this seems a great pity as Mr. Dudgeon, although very strict with regard to quantity and quality of work, is very popular with the workmen of the department as well as with the running staff, and we trust that the rumour of Mr. Thomas' return is untrue, or that better counsels will prevail and keep Mr. Dudgeon where he is.

WASTING PUBLIC MONEY.—*The Morning Post* says:—"The Hibernian Editor of INDIAN ENGINEERING has dis-

covered a nefarious attempt on the part of the President of the late Finance Committee to divert public funds by investing them in a venture which, we are told, is being carried on at a 'dead loss.'" Our contemporary adds: "We are sure Lord Dufferin will put his foot down on such a flagrant job immediately the matter is brought to His Excellency's attention." We shall try this course; but in the meanwhile we would invite the attention of "Great George Street" and the C. E. Members of the House to the disposition of the Government of India towards the representative organ of the Profession in that country.

DEODORISERS AND DISINFECTANTS.—The use of sanitary compounds sometimes falls within the province of the Engineer, and among those that have gained wide celebrity *Jeyes'* claim a prominent place. These preparations include an "Insecticide" which may be used for destroying weeds in paths—particularly gravel walks, and the "Wood Preserver" is considered by many to be one of the best known of its kind, for the simple reason that creosote enters largely into its composition. *Jeyes'* compounds are, judging from the reports of those well qualified to pronounce on them, worthy of the attention of sanitary authorities in this country. The question of their wide adoption is, we think, only a matter of time.

OBITUARY.—It is with great regret that we have to record the death of Mr. Rai Manulal, C.E., at the advanced age of 65 at Arungabad. He was an ex-officer of the P. W. Department of the British Government, where he rose from the position of first native master in the Roorkee College to the post of an Executive Engineer by his tact and ability. The numerous bridges and buildings constructed under his superintendence in the North-West Provinces give a strong evidence of his engineering skill and talent. After he took his pension the late Nawab Sir Salar Jung offered him the post of Superintending Engineer in His Highness the Nizam's Domnions, from which he lately retired on a pension of Rs. 500 a month.

FUEL CONSUMPTION ON INDIAN RAILWAYS.—The most important point is the source of supply. The following table from the Director General's recent report is instructive:—

	English Coal. tons.	Country Coal. tons.	Coke tons.	Patent Fuel. tons.	Wood. tons.
1887 ...	212,529	479,210	9,564	30,029	292,808
1886 ...	240,063	460,948	9,132	26,212	259,513

The most striking fact in the above is that the use of English coal declined by 27,534 tons, while that of native coal advanced by 18,261 tons. Before long the prediction may now confidently be made that petroleum will figure among the descriptions of fuel used on Indian railways.

P. W. D. CIRCLES OF SUPERINTENDENTS, BURMA.—The Government of India having sanctioned the amalgamation of the Public Works Departments of Upper and Lower Burma under the control of Lieutenant-Colonel W. G. Cumming, R.E., as Chief Engineer and Secretary, with three circles of superintendence, it is hereby notified that the divisions subject to each circle of superintendence will be as under:—First Circle,—Head-quarters Rangoon: Rangoon, Arakan, Amherst, Pegu, Toungoo, Bassein, and Henzada divisions. Second Circle,—Head-quarters Thayetmyo: Tharrawaddy, Thayetmyo, Minbu, Taungdwingyi, Myingpan, and Chindwin divisions. Third Circle,—Head-quarters Mandalay: Bhamo, Shwebo, Ruby

Mines. Mandalay Garrison, Mandalay Civil, Kyauksi, and Meiktila divisions.

PROSPECTING FOR MINERALS IN BURMA.—The Chief Commissioner in the Revenue Department notifies that in accordance with further instructions received from the Government of India, it is now ordered that no person shall in future be given an exclusive right to carry out in any given area the preliminary search for minerals which is understood by the term 'prospecting.' Licenses will be given to applicants of approved respectability to prospect for minerals as heretofore, subject to the due observance of the existing rights of owners and occupiers. But such licenses will not exclude other persons who may subsequently receive licenses from prospecting within the same area and will confer no right to a concession hereafter; and if, as may or may not be the case, the Government of India decides to grant concessions, they will not take the form of monopolies.

THE PROPOSED KOLHAPORE STATE RAILWAY.—Within the last few years, the West Deccan branch of the Southern Mahratta Railway has carried the iron horse to Belgaum, 36 miles from Kolhapore, the capital town of the State; and it has now been decided to construct a branch line from Kolhapore to Belgaum, which shall be built and owned by the State, and called the "Kolhapore State Railway." The first sod was turned by the youthful Maharajah on the 3rd May last, and the work is now being energetically prosecuted, under the supervision of the State's Executive Engineer, Mr. Shannon. The Railway will be only 28½ miles long, and the estimated cost of construction is Rs. 22,75,000. The line will be on the metre gauge, and, with the exception of the bridge work, presents no engineering difficulties. The Durbar anticipates a return of 5 per cent. on the money invested.

BANGALORE WATER-SUPPLY SCHEME.—*The Bangalore Spectator* writes:—We draw attention to a letter we republish to-day from *INDIAN ENGINEERING*, on the subject of the Bangalore Water-Supply. This letter will be seen to fall in, as regards the general question, precisely with our own views, as we have previously expressed them. We believe that these views will ultimately prevail: for whatever becomes of General Fischer's scheme, as a scheme, it will have to take its chance on its merits, alongside of others. The absurdity of the business is that the world has been informed that the Bangalore Municipality have adopted General Fischer's scheme. When the nature of the Municipal discussion over the scheme is remembered, and the amount of scientific knowledge of water-projects among the members of the Board is weighed, the "adoption" is a bit of broad farce—exceeded only in its farcical features by the tarnation hurry with which the ring was shoved through.

ITEMS FROM CHINA.—News from Peking states that the Emperor and Empress rode yesterday morning on the Decauville Railway for the first time. This road was supplied by Mr. Thevenet of the French Syndicate. The line is about three miles long and laid on the grounds west of the south lake.—Messrs. Restelhueber and Junot visited His Excellency Li Hung-chang and presented their plans for the armour plated forts. The German Syndicate has also presented a tender.—The work at the gaps in the bank of the Yellow River is progressing very slowly. There is still 800 feet to be done, and Her Majesty is very much displeased with the officials in connection with the work. The French Syndicate's tender to close the

gaps is cheapest, and it is freely reported here that Li will hand it over to Mr. Thevenet. (?) The French Syndicate is to find the finances at 6 per cent. sterling basis, to be paid six months after the gaps are closed, which will be about twelve months in all. If this is true, it is clear that Li must be pleased with the work done by this Syndicate at Port Arthur.—One of the Armstrong cruisers, at their trial on the way to Port Arthur, made a speed of 18 knots, the other 17½ knots. The German boats also have attained their specified speed.

CANALS FOR THE COMBINED PURPOSES OF IRRIGATION AND NAVIGATION.—Mr. G. T. Walsh, Superintending Engineer, P. W. D., Madras, records, in an official memorandum with special reference to such canals in the Godavari district and the necessity for providing other means of traffic between the Kistna and the Gadavari, that it may be accepted as an axiom in canal engineering that the requirements of irrigation and navigation are conflicting, *e.g.*, for *irrigation* large quantities of water, and consequently of silt, have to be taken into a canal, and therefore the slope of the surface must be considerable for *navigation*, the less water taken into the canal, the better, and it therefore should have no slope; for *irrigation* there are times when the canal should be kept low, so that large quantities of surplus water may not have to be passed into the drainages when they are already filled by rainwater; for *navigation* the canal should always be kept up to its full level; for *irrigation*, even when the river or other source of supply is low, it is often necessary to go on letting as much water as possible out of the cannal to supply crops, thereby reducing the level and the depth in the canal, especially at its end; for *navigation* at such times the water should be kept in the canal, to maintain as nearly as possible its full depth.

AN AMERICAN CONTEMPORARY, *Engineering News*, says:—Interesting advertisements from *INDIAN ENGINEERING*, the rupee of 45 cts., silver being translated into its gold value of some 36 cts. are the following:—"Madras Municipality wants a sanitary inspector, salary \$36 per month." "Engineer wanted for the Fyzabad Municipality, salary from \$27 to \$43.20." "Two native surveyors and levelers wanted, salary \$12.60 and \$2.60 horse allowance per month. Apply with copies of certificates to District Engineer, Durbhunga." "Two deputy over-men with coal-mining qualifications on the North-Western Railway wanted. Salary \$39.60 to \$43.20 'per mensem.'" "Head draftsman wanted for the Office of the Agent and Chief Engineer of the Bengal-Nagpur Railway, on a salary of \$72 a month. Applicant must be experienced in drawing and in the management of a drawing office." These, be it noted, are all advertisements for the services of Englishmen who have expatriated themselves for the sake of bettering their condition, and who have a certain amount of technical skill, with the sole exception of the "native surveyors and levelers" who are to luxuriate on \$12.60 per month with \$2.60 horse allowance. We have no doubt that there are better plums than these, but they do not appear in the advertisements, the above being all that appear. On the whole, the tendency of the above should be to make the discontented tolerably content with their lot in this country. That the unfortunate "native surveyors and levelers" should have to take out a "certificate" that they are worth \$12.60 a month before they can earn it, strikes us as rather hard.

ECHOES FROM THE HILLS.

(From our Simla Gossip.)

If the ways of Providence are inscrutable it is not surprising that the gentlemen who attitudinise at Simla as the salt of the earth should occasionally act in a way that "no fellah can understand." Nothing can interest them that does not affect them personally—of their own interests they are singularly careful, but of the wants and necessities of others they would rather not hear. Recently simply because a journal was regarded as a "Service paper" it was decided to encourage its rival; and yet a few of the very gentlemen who aided this decision were peculiarly anxious to bring their own personal grievances to the notice of Government. Intoxicated with their own verbosity they, under the very nose of the authorities and in the face of strict orders to the contrary, filled the Simla Town Hall with their cries of distress. They look, however, with disfavor on a paper which represents in a perfectly constitutional and sober manner the needs of those who have no Town Hall in which to air their eloquence. We repeat that because a technical journal of acknowledged merit was also admittedly the organ of a great Service, the Olympians would have none o' it—they preferred a tame cat of a paper run on commercial principles by a trading firm. But then it is so docile and harmless you know!

* * * *

Engineers, specially those in India, can by no means be regarded as gentlemen, who, in the words of a popular song, sit at home at ease; their duties call them away to isolated positions in unsettled localities and the very nature of their service demands considerate treatment from a not too liberal Government. A recent decision of Government peculiarly applicable to the profession will therefore perhaps be of some interest to our readers. A junior officer serving in Burma was posted to an outlying station innocent of any knowledge of post offices, telegraphs or the other institutions of the white man. The native subordinates who occasionally went to head-quarters were his only means of communicating with the outer world, through them he received his supplies and through them his Chief sent him his salary. About a year ago one of these native subordinates carrying the exiled officer's pay was waylaid and murdered by dacoits, and of course nothing more was heard of the money. The question then arose—Who was to bear the loss, the Government or the officer? The local administration ruled that the loss was the officer's; but after much discussion it relaxed its dignity sufficiently to lay the matter before the Supreme Government and to recommend the grant of a *compensation* to the officer. The use of the word "compensation" established a principle, an iniquitous principle, and made the grant recommended personal. Happily, however, the highest authority has ruled that such losses must be borne by Government and not by its subordinates. The decision could hardly be otherwise.

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To all Engineer officers desirous of joining the Accounts Branch of the P. W. D. we give *Punch's* celebrated advice—"Don't." There may be some few who, incapacitated by sickness from carrying on their *professional* duties, may advantageously change the field for the desk. It is not to these we speak—our remarks refer to those who, dazzled by the rapid promotion of Accounts officers in the past, hope to come in for a share of the good things. In years gone by, owing to the rapid expansion of the department, the growth of railways and the hundred-and-one causes stated in the Public Service Commission reports, promotion was rapid, far too rapid if anything, for the block now existing, and coming so soon after such

prosperity can only engender discontent in the various grades of the service. Major Begbie, the present Accountant-General elect, was, in November 1874, a Deputy Examiner of Accounts, or holding rank corresponding to that of an Executive Engineer fourth grade. He is now, within a period of fourteen years, Accountant-General with the rank of Chief Engineer first class. Major Begbie arrives in India next September and serves the regulation period of five years; his successor will be Mr. R. G. Macdonald who, in all probability, will be followed by Major Christie. These three changes will cover at least the next fifteen years, perhaps more, and we ask the gentlemen who like to prophesy by the book, to look up the classified list and say how long it will take the men now in the Accounts Branch to rise three steps in rank?

* * * *

Colonel Conway-Gordon has at last published his Administration Report on the Railways in India for 1887-88, and a footnote informs us that copies are "to be purchased from the Superintendent of Government Printing, Calcutta." To what base uses may not the poor depreciated rupee come! The Report itself forms a goodly sized volume of the orthodox blue, but, after all, it is but an exemplification of the saying, "muckle cry and little 'oo'." "The leading events," says the Report, "in the history of railways in Indian during the year under review may be briefly said to comprise the opening of the system of Military railways on the frontier and the commencement of a tunnel through the Khojak-Amran range, the opening of the Southern-Mahratta Railway through to the sea coast at Marmugao, the progress made in Railway extension in Burma and in famine protective lines in the Madras Presidency, the opening of the 'Dufferin' and 'Balawali' bridges over the Ganges, of the Ferozepore bridge over the Sutlej and of the bridge at Kalpi over the Jumna and the formation of the Bengal-Nagpur Railway Company." These landmarks of railway history and less important events, take the Director-General of Railways over 120 quarto pages, to record! Of his own doings he is modestly silent, but we suppose his report justifies his existence.

* * * *

Hard-hearted Secretaries of State for India have professed their inability to grasp the *raison d'être* of the great Railway Directorate at Simla with its half-a-dozen highly paid officers and three score and ten clerks. They wanted the Director-General to employ himself usefully in supervising the few lines administered by the Supreme Government, to examine the working of lines and assist towards a harmonious and uniform system of working—all this of course with a very much smaller establishment than he has. A new Daniel has however now come to judgment, and he has permitted the amalgamation of the office of Director-General of Railways with the P. W. D. Secretariat on the condition that the railways now under the Government of India will be handed over gradually to the several local Governments, and that the office establishment at Simla will be correspondingly reduced as the decentralization progresses. Arrangements are now in progress to that end, which will leave only one line—the East Indian Railway—under the direct control of the Government of India, and the practicability of placing under one local Government a line of railway running through two such large and important provinces as Bengal and the N.-W. Provinces is exercising the wits of the officials at Simla. Both the local Governments have been addressed, and it is possible some solution of the difficulty will soon be arrived at. With the decentralization complete the Director-General of Railways will take a back seat in the P. W. D. Secretariat at Simla—where the wicked cease from troubling and the weary are at rest.

Current News.

A new Fine Arts and Industrial School is about to be opened at Trivandrum by Government.

LAST year the total number of passengers who travelled by railway in India amounted to 95½ millions, of whom 89 millions were third-class.

MR. BIGG-WITHER is now in Simla on the subject of the petroleum deposits in Kelat. These being in the open plains are more accessible than those at Khotan.

THE long questioned identity of the Sangpo, or great river of Tibet, with the Brahmapootra of the Indian plains may be said to be now at last finally set at rest.

LIEUTENANT C. E. BADDELEY, R.E., Company Commander, Bombay Sappers and Miners, has been allowed furlough to Europe for one hundred and eighty-two days on medical certificate.

THE Public Works Department of the Government of India has ruled on a recent case, that the chaplain of a church cannot be permitted to let any portion of his parsonage and appropriate the rent to himself.

THE Government of the Central Provinces purpose to make certain concessions to a Mr. Perroux, of Calcutta, with a view to granting him leave to prospect for diamonds in the valley of the Mahanadi river near Sambalpur.

WE understand that it has been recommended to the India Office that the appointment of Professor of Forestry at the Royal Engineering College, Cooper's Hill, should be made a permanent one, and that Dr. Schlich, who is at present filling it, should be confirmed in the post.

THE Administration of the Central Provinces are about to start a Technical School at Nagpur, which will be worked in connection with the Local Agricultural Department, and a sum of Rs. 1,500 has been sanctioned for the purchase of books and apparatus required for the school.

THE Managing Board of the Victoria Technical Institute have appointed Mr. J. P. Phythian, a gentleman prominently connected with technical education at Oldham and Manchester, to the office of Principal of the Bombay Institute, and the new Principal has arrived and assumed charge of his duties.

BURMA rice, in spite of the export duty, has held its own in the markets of the world, and even the increasing exports from Siam and Saigon have not materially affected the demand for Burma rice in China and the Straits, which are so much more conveniently situated for getting their wants supplied from Bangkok or Saigon.

THE Seringapatam (Mysore) Gold Fields, Limited, is registered with a capital of £200,000 in £1 shares. The stated object is to acquire certain leases granted to Messrs. MacDowell and Co. and Messrs. Arbuthnot and Co, respectively, of mineral lands and mining rights in the taluk of Seringapatam, in the Mysore territories.

IT is intimated that that portion of the Toungoo-Mandalay Railway extension beyond Toungoo to a station called Thamati, will probably be opened for passenger traffic on the 1st proximo, and from Thamati to Pyinmana on the 15th proximo. The fares and times for trains running to these stations are published in a time table dated 20th March.

THE Annual Fine Arts Exhibition at Simla will, it is said, take place between the 25th August and 15th September, and the supper and small ball-rooms in the Town Hall have already been engaged from the Municipality for that period. Mr. G. B. Hodgson, R.E., of the Survey of India Department, takes up the duties of Honorary Secretary for the season.

THE Health Officer, Dr. Simpson, has explained to the Corporation that in stigmatising the sanitary condition of Calcutta as no better than that of an "African village," nothing was further from his thoughts than a desire to offend the dignity of the Town Council. And Baboo Surendronath Banerji, on behalf of the offended members, accepted the explanation.

GREAT improvements are, we hear, being made to facilitate the working of the Madras Harbour traffic. Two new lines of rails are being laid diverging from the shore end of the pier, one running north along the north shed and terminating in the harbour line, another running south of the south shed and terminating also in the harbour line. These lines are for the benefit of the coasting cargo, and will save a great deal of coolie hire.

THE Government of India has ruled that the appointment of Sanitary Commissioner in all Provinces shall be limited to a tenure of seven years, with an extension of three years on the recommendation of the Local Government. The object of this is to secure the appointment being held by comparatively young men, as the inspection duty of the office is arduous, if energetically

pursued; and this is essential, if sanitary progress is to be hoped for.

THE work of widening the Umballa Railway platform has been taken in hand, and is being briskly pushed on. The old rails have all been pulled up, and it is in contemplation to increase the width of the platform by some dozen feet or more. This will effect a great improvement in the present building, and will render it better able to meet the crush of traffic when the Imperial and Punjab Government Offices are on the move to and from the Hills.

FOUR new sheds are to be erected, one to the south of the north shed and one to the south of the south shed, and one on each side of the shore end of the Madras pier. As the Municipality claim that the harbour has made an encroachment of 6 feet on the Beach road, the existing fencing is to be moved that distance to the east, as also the present lines of rails and the 8 cranes near the south shed. A new crane for lifting heavy material is to be erected near the north shed. The work is progressing rapidly.

LAST year a Committee sat at Calcutta to examine the system of accounts in the Ordnance establishments, and report whether it could not be applicable to the working of the Harness and Saddlery Factory, Cawnpore. The Committee, in going through the Accounts of the Foundry and Shell Factory, the Small Arms Ammunition Factory, the Gunpowder Factory, the Gun Carriage Factory and the Harness and Saddlery Factory, agreed that no system of accounts could be better than the one in operation in the Ordnance Department.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

A GOOD IDEA.

SIR,—A scheme is on foot for expediting conveyance of the English Mail between Bombay and Calcutta, and *vice versa*. Sir Charles Elliot is understood to be much interested in it, and it has the cordial support of the trading community. The notion is that the trains carrying English Mails and Mails for England should travel faster than they do now, that they should be out and out specials; not only driven at a higher rate of speed than other, but stopping scarcely anywhere—veritable 'through trains' in all senses of the term. Properly managed, they might, it is estimated, save nearly 24 hours in the journey across the Continent. In which case through passengers bound for England instead of having to leave Calcutta at 9 o'clock on Tuesday evening would make their start at 7 P.M. on the day following, their train arriving in Bombay at 3 o'clock in the afternoon of Friday. A similar train would leave Bombay on the arrival of the English Mail there, and would effect a corresponding saving of time in the journey to Calcutta. Such trains would be fitted with a kitchen and dining saloon, so that passengers might take their meals on board. The idea has much to recommend it, and I hope that it will be carried to successful issue.

TRAVELLER.

O TEMPORA! O MORES!

SIR,—All the nations of the world, uncivilized as well as civilized, are given to perpetuation of the memory of their citizens' heroic deeds by means of a monument of some sort, a temple of honor, whatever form it may take, and sacred from profane usage. Sacred in the regard of all the nations of the world—except Englishmen. The bump of reverence they are endued with shrinks to infinitesimal proportions at times. For which reason I have now to deplore and denounce an act of desecration at Delhi, at the old arsenal, where, at the time of the mutinies, nine Englishmen kept an army at bay as long as they could, and then fired the magazine to prevent its falling into the enemy's hands. Kaye writes of this act of devotion:—"The effect of the heroic deed which has given to these devoted nine a cherished place in history, can never be exactly computed. But the grandeur of the conception is not to be measured by its results. From one end of India to another it filled men's minds with enthusiastic admiration." And to-day of two towers supporting the archway of a gate that used to be the entrance to the magazine; the one on the right hand is used as a kitchen by the Telegraph Master; that on the left hand as a—latrine. That is an altogether English and unique way of shewing respect for the memory of men who died for their country. Verily, *dulce et decorum est pro patria mori*.

BRITANNICUS.

MOORE'S IMPROVED CAST IRON SLEEPER.

SIR,—While agreeing in the main with your remarks on "the latest improvement in Railway sleepers" which appeared under the head of "Notes and Comments" in your issue of the 23rd instant, I cannot refrain from drawing the attention of the interested public in general, and the inventor in particular, to some of the defects of this otherwise efficient sleeper.

In the first place the rail resting on the bare shoe or plate without a non-corrosive medium will induce rapid oxidation, and consequent deterioration of that portion of the rail surface which comes in immediate contact with the plate.

2. The buckle or jaw in which the T tie fits and is cotted to gauge, is far too weak to withstand the lifting force tending to displace the tie bar.

3. The plate is extremely weak at the cross section, through the centre of the trough which receives the rail in contact, and therefore useless when it breaks along that line.

4. Unless the plates and other parts of the sleeper are accurately made to gauge and the rails uniformly drawn, the gauge of the line will be irregular and untrue.

5. Wear and tear of the small parts and oxidation of the tie ends will tend gradually to disturb the gauge necessitating change of some of the parts.

These are some of the defects of the 5' 6" gauge sleepers which appeared to me at first sight, but its study more carefully by others having more leisure at their disposal than I can command, might bring to light others, or perhaps correct those I have arrayed above.

RAILROADER.

THE BATTLE OF THE ARCHITECTS.

SIR,—Not long ago, you hesitated to congratulate the Bombay Municipality on at last bringing the question of their New Buildings to a successful issue, fearing that you might be premature, and you were quite right so far, but quite wrong in imagining that the clock would be put back again; it has been put forward with a bound which must astonish even the Members themselves! For three years it has been "pull devil pull baker" about the site, and "pull devil pull baker" about the sum. For three years Mr. Chisholm has been planning and explaining. When—hey, presto!—Mr. Stevens the Architect of the new Victoria Terminus appears on the stage as harlequin, and the grandest transformation scene known to any Municipality is at once evolved. Enter two Daily Editors as Clown and Columbine. Columbine greases the slide, on which the old gentleman (Mr. Chisholm) falls—his pocket is quickly picked by Clown. Harlequin touches him with his wand—he is shot through a shutter on which appears the words "a neat turn out." Enter twenty-one beasts labelled "Corporation—" characteristic dance and strong chorus of beasts. Harlequin touches them with his wand, and the beasts change into Bottom and twenty fairies! The whole scene closing with a beautiful effect of the shower of gold! In sober truth this is exactly what has occurred. Mr. Stevens supported by the two leading daily papers at the eleventh hour, offered his services to the Municipality, and they have been accepted by a large majority! Of course there is a good deal which one cannot understand at this distance. It nowhere appears for instance how the Municipality got off with the "old love" before being "on with the new". For Mr. Chisholm has most undoubtedly been employed for about three years; of one thing however there can be no doubt, the Bombay Municipality are really going to have a handsome building, and we congratulate them heartily. The illustrations which you published of Mr. Stevens' elaborate work, cubes about 4,100,000 feet, and the building cost 27 lakhs of rupees, so that the Municipality must contemplate spending some 14 or 15 lakhs. This is exactly as it should be, but the jump from 5 to 15 rather takes away one's breath!

FAIR COMPETITION.

IRRIGATION IN MADRAS.

SIR,—There have been in recent numbers of INDIAN ENGINEERING, letters from some person or persons claiming authority on the subject of Irrigation in this Presidency. It is very much the custom in Madras to let the outside world wag on, call us benighted, hidebound, purblind, lethargic and the rest of it, while we attend imperturbably to our own business, well aware that the outside world as a rule, knoweth not what it says. But when anybody from Madras itself begins to criticise, that is a different matter, as he will be assumed to have some knowledge of his subject. As a matter of fact, the persons in question have very little, and without trespassing unduly on your space, it may be as well to place on record that no reliance is to be placed either on their figures or their deductions.

The last of the letters to which I refer, is that signed "Prudence" in your issue of 2nd June. He first exposes the ill-success of the Madras Water-Supply Scheme, and infers a similar ill-success for the Periar Project, though the conditions of the two are as different as can be conceived. The fact is that whatever "Prudence" knows about the first, he knows nothing about the second. The Periar Project is intended to bring water from the hills to the plains, from an unhealthy jungly elephant-haunted unpopulated tract to a populous district crossed by a Railway and surrounding one of the largest towns in Southern India. Even a Government, as your correspondent might say, is not such a fool as to try to turn a hilly, jungly unpopulated tract into an irrigated plain.

The point is, that if "Prudence" is evidently mistaken in one portion of his facts, how are we to trust him and his like in

others? Particularly when the mistake is due to want of the most elementary study of his subject. How do we know that his figures for the Madras Water-Supply are correct? Or his statements about other large Irrigation Works? It is seldom that anyone has full means, time, and inclination for checking either General or Statistical statements, and in this case unless accompanied by chapter and verse they are not to be trusted. The truth is that Government does consider these Irrigation Projects most cautiously and laboriously, and the result is that they are on the whole a splendid success. The Cauvery Delta System returns cent per cent., clear nett unadulterated profit, the Kistna and Godavari each about 10 per cent., others less: but nearly all of them pay. It will perhaps surprise "Prudence" to hear that the Periar Project has been considered since nearly the beginning of the century; and yet this fact is one of the first to meet the eye in the book on the Periar Project published by Government, which "Prudence" has not read.

Of course it is human to err, and there have been some bad failures; but it may be taken as certain, that the lessons have not been thrown away. Engineering suffers as well as gains from dealing only with the visible and the tangible. When the loss is represented by so many rupees, everyone appreciates it, and howls. The far greater loss occasioned by an ill-judged law, an ill-selected Viceroy, or even an incompetent Magistrate, is not so easily expressed in terms of our experience, and so is less noticed. Hence a good many of the tears shed over the Public "Waste" Department.

PERIAR.

MADURA; June 12, 1888.

THE MANDALAY STATE RAILWAY.

SIR,—The Traffic Superintendent of the above line gave public intimation that the line from Toungoo to Pyinmana (formerly Nyingyan) would probably be available for goods traffic on the 20th April last, and subject to the orders of the Government of India, it will be opened for passenger traffic about the beginning of May. It is now intimated that the line will be open for goods traffic in August and for passengers by the end of the year.

Plate-laying was completed some two months ago, so that the original intention of opening might have been carried out but for the grave apprehensions it is understood are entertained of the stability of the line at certain points during the rains in Upper Burma. About midway between Myitha and Thabyadong the line passes over a very low-lying marshy district, peculiarly subject to sudden and severe inundation from the Ohan hills on the east and the large tanks or lakes at the base of these hills, and in this length, probably 5 to 7 miles, the flood openings provided are certainly insufficient both in number and capacity. This portion of the line is in the 6th Division, and, like everything else in that division, was constructed in the most happy-go-lucky, rule-of-thumb, style. For instance, the centre line was not preserved in throwing up the embankment, the lines indicating the toe slopes are nowhere, and as for the chainage, one might as well, and with equal chance of success, explore our next neighbour—the moon.

In the 5th Division the chainage was preserved by stakes 6" to 9" diameter, sunk 3" in the ground, and showing height of bank at formation level, allowance (2" per foot in height) for shrinkage and 1' clear above all this for painting the chainage on. In addition to these, which were at every 10 chains, 2 stout pegs 4" x 4" and 3' long were driven at right angles to the stake in centre line, and well clear of the slopes, so that if the stakes in the centre line should by any means get broken or burnt, the true centre and exact chainage could be found by stretching a line between these two pegs, the peg on the east having the chainage painted thereon. Ample provision of flood openings was also left in the embankment.

In the 6th Division everyone of these precautions were neglected, and one consequence was that, when the temporary timber bridges were constructed, scarcely one of those that should have been on the true centre were so. This was notably the case with a ten-foot opening a few chains north of Myitha station.

The late Executive Engineer, 6th Division, having spent the greater part of his service of upwards of 26 years in the highly scientific work of re-aligning, extending and patching up generally old native tracks in the province of Bundelkund, it is scarcely to be wondered at that he found himself in a fog when pitchforked into the Railway Branch by a discerning and paternal Government. Verily, the ways of the Imperial Government of India are inscrutable and generally mysterious to the outside world.

The total length of this line as completed, except bridges, ballasting and station buildings is some 445 miles, leaving something like 255 miles to complete to Bhamo, and the line to be of real utility should have been pushed up to that important station, as it is understood it would by this extension tap the China trade. It seems a pity also that the bridges and embankment should not have been constructed for a broad-gauge eventually, but with the usual narrow-minded, penny-wise-and-pound-foolish policy of the Government of India, this has not been done, and as everyone predicts that Burma has a splendid future before it, a broad-gauge

line will probably be found necessary some ten or twelve years hence; then patching bridges and embankment to render the line suitable will be a work of some difficulty, as new freshly laid on earth will never take kindly to the old slopes and slips, and subsidence will be the consequence; whereas all this would have been avoided had bridges and embankment been constructed for a broad-gauge line in the first instance.

Finally, when the line has been opened for passenger traffic, it is to be sincerely hoped that better arrangements be made in the way of refreshment and waiting-rooms than those in force on the open line at present. At the Promenade station on disembarkation from the steamer from Mandalay there is a detention of five weary hours to be endured, without being able to obtain so much as a cup of tea; and on the Toungoo open line, if the complaints of travellers in the Rangoon papers are reliable, a similar state of matters seems to prevail. It is to be hoped these matters will not escape the attention of Colonel Conway-Gordon, C.I.E., R.E., on the occasion of his next inspection, as they seem to be either beyond the grasp or beneath the notice of the local officials, who are nevertheless well paid for apparently extremely light work.

SAD EXPERIENCE.

THE GOVERNMENT OF INDIA VERSUS "INDIAN ENGINEERING."

SIR,—I was reading the other day about an ingenious and ingenious gentleman who busied himself in evolving from his inner consciousness a plan for an improved system of perpetual motion. The only thing needful to the success of his ex-cogitations was practicality, and that he conceived could be attained with the aid of a Government subsidy. So he applied for one to the Court of Requests, urging that he wanted to be able to live comfortably while his inchoate invention chewed the cud and perfected itself in his mind's eye. It was a very paternal Government this gentleman had the luck to live under, and his petition was granted. Only one member of council opposed it on the ground that the Government stood committed to Free Trade principles which were opposed to meretricious subsidies. But he was overruled, the argument employed against him being that Government had need of popular support; and the subsidy was sanctioned. Whereupon the embryo inventor looked forward with much complacency to leisurely working up of his ideas into some practical application to the business of life. But he found that he had reckoned without his host, that the paternal Government was not such a fool as it looked, that it did not by any means believe in having the reciprocity all on one side, but meant to get a *quid* for a *quo*. Wherefore it happened that all the lucky man's leisure time was taken up with Government commissions; his wits rusted under the damp sheets of official dictation; his great expectations dwindled down to temerity; and, as if to fill the cup of his bitterness to the brim, another man took up a really practical idea he had abandoned for the sake of Government patronage—and made a good thing of it. It is a suggestive little story, and like the game of fox and geese has its moral and instructional bearings; and as one of those who induced you to start *INDIAN ENGINEERING*, I have retailed it for public edification and warning. Precedents are sometimes mischief workers in a community.

Now for the outlines of a story of later date, of our own day and generation. It concerns *INDIAN ENGINEERING*, and supporters of that Journal are, I venture to hope, interested in its interests. It was such a hope that, notwithstanding other inducements, persuaded you to undertake and continue in the conduct of the paper, and to submit to all the demands upon your time and patience that such a position involves. But to the story. Other efforts having admittedly failed in journalistic efforts to satisfy the requirements of the profession, you started *INDIAN ENGINEERING*, which, dependent entirely on its own merits, has won for itself popularity and support, while the rival organ has been continuously losing ground. With collapse staring it in the face—making that inevitable collapse if left to its own devices an excuse for their appeal—the proprietors of the said rival organ made application to Government for help. And Sir Charles Elliott has passed orders that 200 copies of that journal shall be paid for by Government. Of course, by virtue of this bargain, your contemporary's hands are tied, journalistic right and duty of free criticism and comment has been sold, Esau-like, for a mess of pottage. The propriety of the bargain from that point of view is, mainly, a matter for trade and conscience to settle between them. I do not care to expatiate on that phase of the subject. But I, with other members of the profession do care for fair play at the hands of the Government. Fair play is all you asked for. Let the Government in consonance with its Free Trade professions—withdraw its unjustifiable subsidy; let there be fair field and no favour for *INDIAN ENGINEERING*; and very soon, in this matter at any rate, there will no longer be room for doubt in men's minds as to Darwin's dogma that the fittest survive. It stands to reason that, when the public was appealed to for support by your contemporary, that that public, having had its eyes opened, could institute a comparison between the rival papers as to literary merit, scientific and professional information afforded, and so forth. But your claim to fair treatment, also rests on the grounds of justice, and a broad economic basis.

Government, while making profession of Free Trade principles, has cast them to the winds, in order to aggrandize your rival. Or rather, I should say, in order to have a quasi-professional mouth-piece at its beck and call. It knows full well that you would never consent to such a nefarious bargain—it has had to make its market where it could. Government's money is being wasted; its supposed expression of opinion is being bought and sold; a demoralizing precedent is being set up, to mock it. Will it allow such a scandal to endure? It should bear in mind that an injustice and injury done to one citizen to-day, and not followed by popular reprehension is likely to be repeated in another form at some other citizen's expense to-morrow. *One and all* is the Cornish motto. It has been acted up to with beneficial effect by Cornish men very many times, and in very many ways, since 7,000 of them marched to London, and rescued Bishop Trelawney from the Law's unjust sentence of death. I have faith in the popular voice, and believe that it will see justice done to you since all you want is *FAIR PLAY*—a fair field and no favor, and let the best man win.

EQUITY AND CONSCIENCE.

LUCKNOW ARTESIAN WELL.

SIR,—The Government of India is often very aptly termed an irresponsible Government. So long as it pleases its own sweet will it cares not a straw what happens. This, Mr. Editor, has been the policy of those in whose hands are entrusted the destinies of the teeming millions!

It would appear that in the higher grades of officialdom the cranial excrescences, commonly called bumps, have attained marvellous proportions, and nothing short of deliberate shovelling out of the Imperial Exchequer money drawn from the very vitals of the impoverished population of the country seems to please them. Public opinion is treated with supercilious contempt by these high-born or 'Cerulean' beings.

Look at the enormous sums the Sind and Peshin Railway, the Madras Harbour, the Scientific Frontier, the Cabul Subsidy, the Kali Nadi Aqueduct, the Viceregal Palace and other works of public and political importance have cost and are costing the country whose blood is well nigh dry by these and other ex-vexations.

In this connection it would not be out of place to mention the *fiasco* that has attended the Lucknow Artesian Well or boring, which, having attained the depth of 200ft. or thereabouts, has now come to a standstill, because of the hole having run crooked or dog-legged, and this, be it mentioned, under the control and supervision of an experienced Yankee cousin specially brought out, and with the aid of steam boring machinery. To prosecute this depth it has already cost the Municipality nearly Rs. 40,000 in machinery, and we are told that a further sum of Rs. 15,000 will be, or is, invested for the introduction of fresh boring apparatus, and before the work is fairly set a-going the undertaking will cost the Municipality the round sum of Rs. 1,00,000, as against the estimated cost of Rs. 60,000. It is exceedingly ridiculous that a small work like this should commit the Municipal Board to the expenditure of such large sums, but this is not at all surprising, as it is the fashion with our *Ma-Bap* Government now-a-days to be generous to a fault with other people's or public money.

Borings have been put down by the ordinary spring pole, with other accessories, worked manually, to the depth of several hundred feet by experts in England and America; and in this country also depths of 300 to 400 feet have been attained by the same process. A complement of 12 to 16 coolies of ordinary physique and strength, costing Rs. 3 to Rs. 4 per diem, will, without the aid of the spring pole, but the assistance of a derrick and a winch, prosecute holes to the depth of 200 to 300 feet in alluvial soil.

Without the aid of the derrick and a winch, 16 men have pierced 200ft. in carboniferous strata at a daily cost of Rs. 3 to Rs. 4. Omitting depreciation of appliances, which in small depths is insignificant, and at contract rates,—8 annas for the 1st 50ft., 12 annas for the next 50ft., and 4 annas per foot for every 25ft. beyond the 100 and up to 200ft. as a limit,—the boring of 200ft. in depth has cost me Rs. 224 for labor and Rs. 26 incidental charges, making the total cost Rs. 250, or Re. 1-4 per foot. Rates however are variable according to locality and circumstances. A team of experienced borers from the Bengal coal-fields, headed by a sirdar or an experienced and intelligent East Indian or Eurasian, would have shewn far better results than our *cutie* trans-atlantic friend invested with all the glory of his national prestige.

Verily there is something either in the atmosphere of the country which deteriorates, dulls or otherwise incapacitates the energies, mental and physical, or in that of the official world which attains the maximum of congeniality when it admits of all the energies of its members being concentrated in the capture and care of a herd of White Elephants. Reflect on all these, Mr. Editor, and grow wiser than the inhabitants of the blue whose sensibilities are manifestly not of the order called *tender* or *impressional*.

INDIAN COLLIER.

[The Government of India has only an indirect responsibility in this matter, less than that of the Provincial Government which sanctioned the Municipal "Proceeding."—Ed., I.E.]

Literary Notices.

THE ECONOMIC USE OF THE PLANE-TABLE IN TOPOGRAPHICAL SURVEYING; By Josiah Pierce, Jr., M. A., Assoc. M. Ins. C. E. Pro. Inst. C. E. 1888.

The plane-table which is advocated in this pamphlet is not the plane-table that is so familiar to most surveyors in this country, but is an altazimuth instrument of precision and is particularly well adapted for topographical work on all scales, for the simple reason that, by proper construction, the angular errors in the measurement of azimuth angles can be so far eliminated in practice that they may be neglected.

The lower plate of a transit theodolite is expanded and becomes the plane-table board and the vernier or index is replaced by a straight-edge which, with the telescope and vertical arc, is commonly called the 'alidade' or by the Germans the 'kipp regel.' The alidade is in general detached, but in the Edgeworth stadiometer it is attached, each sheet being but the record of the work done at each station.

The relative advantages of the different kinds of plane-tables used in different parts of the world are gone into in the pamphlet. The first requirements in all kinds of the instrument are that the upper surface of the table should be plane, supported rigidly in a horizontal plane and have a vertical axis of revolution about which the table can be turned for adjustment in the meridian without disturbing the rigidity or level. The instrumental errors introduced by the alidade are three:—An error of collimation, an inclination of the transverse axis and the board or plane of the ruler being out of level. The azimuth error occasioned increases rapidly from the latter two causes with the angle of elevation; but in a flat country slight errors of level and inclination produce inappreciable errors in the azimuth angles and this accounts for the remarkably good results obtained in India with rough plane-tables. The error of collimation produces but one-tenth the effect of a similar error in the transverse axis.

The pamphlet under review was read at a meeting of the Institute of Civil Engineers and a protracted discussion ensued. General J. T. Walker, C.B., late Surveyor-General of India, among those taking part in it, may be mentioned and Lieutenant-Colonel T. H. Holdich, R.E., of Afghan Boundary Commission fame. General Walker said that in all the arrangements shewn by the author, the object appeared to be to convert the plane-table into a universal instrument. In India nothing of the kind was attempted. The instrument was only used for filling in details in ground which had already been either trigonometrically surveyed or traversed.

It appeared to Colonel Holdich that the difference between the American and Indian systems was one of degree only. It was a question of drawing the line when precise triangulation ended and graphic triangulation began. In India the triangulation was carried further than in America. In frontier work the topographers were subject to great vicissitudes and a plane-table might meet with accidents, so that they could not afford to take instruments of such refinement as the author advocated; but he thought that Military Engineers should be very much indebted to the author for the light he had thrown on the subject, with regard to which there had been very little literature.

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General Articles.

THE SEWERAGE OF THE FORT OF MYSORE.

BY STANDISH LEE,
Sanitary Engineer, Mysore State.
PHYSICAL FEATURES.

THE Fort covers an area of 52·3 acres, and the general fall in the ground from West to East is 40 feet and from North to South 8 feet.

The natural line of drainage is therefore from West to East; and the lowest level is along a water-course running North and South, parallel to the Eastern rampart, but removed 150 feet from it towards the West.

The whole area within the walls of the Fort therefore is, practically, an inclined plane, there being neither ridges nor valley lines from North to South.

The strata consist of gravel, decomposed granite and soft rock, as shewn by the sections of borings made at several points. The water-bearing line, arrived at by measuring the high water level in private wells, shews that neither water nor rock will be approached by any of the proposed sewers.

GENERAL DESCRIPTION OF THE SCHEME

For convenience of sewerage, the whole space has been divided into three sections, (Plate I,) consisting of the following areas and populations.

Names of Sections.	Area in sq. feet	No. of houses.	Population.
No. I., or Southern Section ...	450,000	195	1,065
No. II., or Central " ...	730,000	104	930
No. III., or Northern " ...	1,120,000	301	2,040
Total	2,300,000	600	4,135

The area, as already stated, is 52·3 acres, and the population 4,135; the number to the square mile is therefore 50,700, which is higher than the density of the most crowded European cities: the population of London being 30,000 to the square mile. The number of houses is 600, and the average number to each house between 6 and 7. This does not include the population it is proposed to remove and which number over 500.

In this Scheme rainfall is not regarded as sewage, and therefore the size proposed for the Sewers and their cost are reduced to a minimum. On this subject Sir Robert Rawlinson, C.B., President of the Sanitary Institution of Great Britain, in his address delivered on September 30th 1884, said:—"Some Engineers have thought, that the heaviest known rainfall of a district must be provided for, hence calculations have been made as to the capacities of sewers to remove some exceptionally heavy volume of rain within the hour; but if this rule were worked to, main sewers in our climate—for such populations as Birmingham—would have to be as large as railway tunnels; and for cities in India, such as Calcutta, Bombay, or Madras, main sewers of the dimensions of railway tunnels would not serve, because rain occasionally falls at a rate of one inch per hour for many hours in continuance."

All three sections will drain in the same direction, *i.e.*, from West to East; and though the pipes follow the natural slope of the ground, the water-courses do not in any instance form pipe tracks, but are reserved, with the covered brick drain in them, for the discharge of surface water. Each section has a secondary sewer, into which all the primary or street drains of that section discharge their contents; and the secondary sewer, in its turn, empties itself into the main sewer. This sewer skirts the eastern rampart, and extends the whole breadth of the Fort from North to South. It is continued through the water-gate and outer ditch, into the open masonry outfall drain for the town sewage, at the South-east corner of the counterscarp of the Fort.

While this arrangement fulfils the conditions as to the fall, &c., required for an efficient system of sewerage, it also possesses the great advantage of not interfering with

the existing covered drains, which were built at the beginning of the century by that famous Minister, Poorniah, and which, as will be hereafter shewn, have been systematically designed and are quite efficient for the discharge of rainfall.

The proposed outfall, as already stated, is the existing town drain, and though its location, as a whole, in reference to the Fort, *viz.*, along its eastern face—is most objectionable, and must be remedied when providing for the sewerage of the town, yet in the small portion it is proposed to utilise, from the counterscarp to its end, Plate I., is however not only unobjectionable, but is the most favorable position that could be selected for the outfall of the Fort. In fixing the position of a work of this nature, it should not be in the direction of the prevailing winds, as then currents of air are produced in the sewers and discharged, with foul gas, by the ventilators within the influence of the houses. Reverse currents also impede the flow of sewage and promote deposit of sediment. By the wind-chart, Plate II., it will be observed that from June to September the prevailing winds are those which blow between South and West, and these winds would carry the smell of the sewage away from the Fort. The other direction, which is that of the North-east monsoon, is equally favorable, as the winds from that direction, which prevail from the middle of October to January, would also blow away all poison from the Fort.

All the sewers are laid in straight lines, as will be observed by the index map, Plate I., and at gradients calculated to generate a velocity sufficient to be self-cleansing. At every change of line, or gradient, and at distances not exceeding 300 feet, a man-hole or lamp-hole with moveable cover is provided. The man-holes will be oval, because that form is cheaper than any other, as it requires less brickwork. These arrangements are to facilitate inspection and cleansing by flushing without having to break up the ground. The sewers, being true in line, can be seen through, from man-hole to man-hole, or from man-hole to lamp-hole by suspending a lighted lamp in one of them and sending a man down the other. At the surface, the lines of sewers can be sighted from cover to cover, and the overseer in charge will know exactly where to dig to find a side junction. Ventilators are provided in combination with man-holes and lamp-holes at every break in the gradient, Plate III., *figs.* 1 and 2.

In cases where more pipes than one enter a man-hole, the outfall pipe is placed at a lower level than the others, Plate III., *fig.* 5. The object of this is, by breaking the sewer into short lengths, to prevent transference of sewer gas from one portion of a section to another, so that gas formed in each length of pipe may escape at the upper portion of that length, and not travel the whole line of the sewer. This arrangement also provides a free outfall for each inlet pipe, and prevents loss of velocity in passing a man-hole, when one of the several pipes is running full-bore, and sewage is headed up in the man-hole. It will be observed that these breaks are more numerous where the gradients are steep, as otherwise the pipes would act as chimneys for drawing off the foul gas from the lower to the higher parts. No. 1 secondary sewer, with its primaries, is an instance in point. The fall from A. to B, Plate I., being 50 feet, if the several breaks shewn on the sections were not introduced, it would act virtually as a chimney of that height to ventilate the lower portions of the sewer, and to poison houses at the upper end with foul gas.

Flushing is necessary, in all systems of sewers, to preserve them clean and free from deposit. Provision has therefore been made at the points marked F., Plate I., for using Kookarhully water for this purpose. The works consist of a man-hole, as shewn by *fig.* 3. Plate III. A few of "Field's automatic flushing tanks," *fig.* 4, Plate III. are also provided for use at the Palace, and at points where large quantities of water are used. These tanks accumulate any water turned into them up to the capacity of the tank,—which may be from 50 to 5,000

Index Map of

REFEREN

Street Drain

Secondary Drain

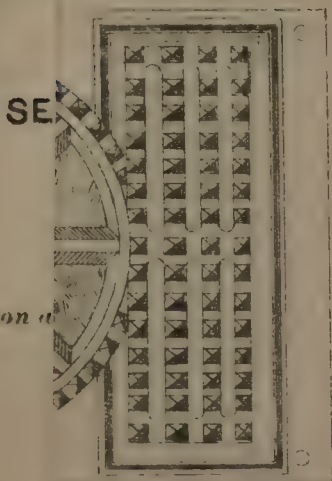
Main Drain

Man Hole

1. 1. Hole

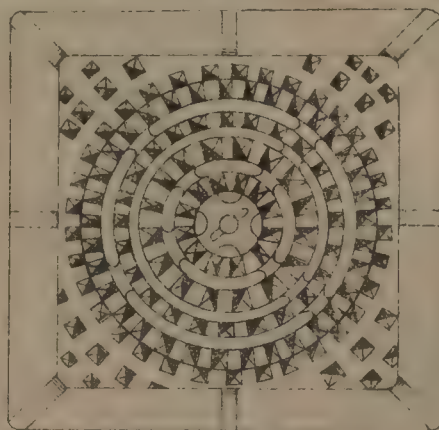
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VENTILATING GRATE.



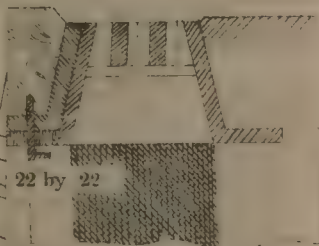
by 22."

PLAN OF VENTILATING GRATE WITH REMOVABLE PLUG.

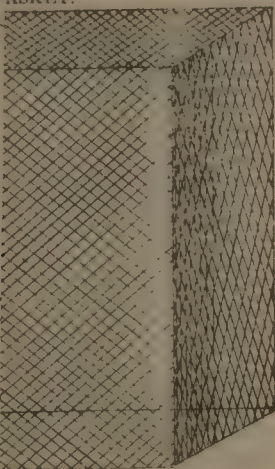


Entrance 22 by 22.

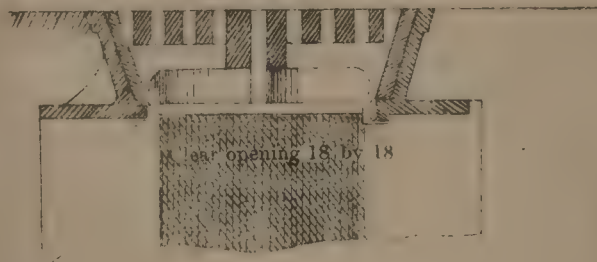
F



ASKET.



SECTION.



CHARCOAL BASKET.

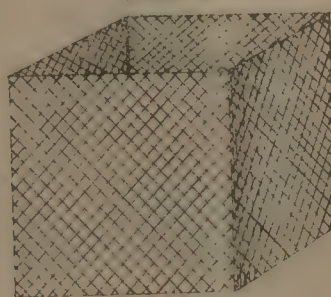
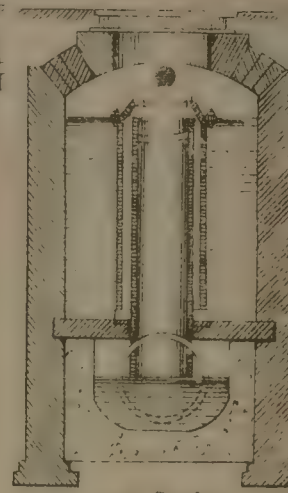
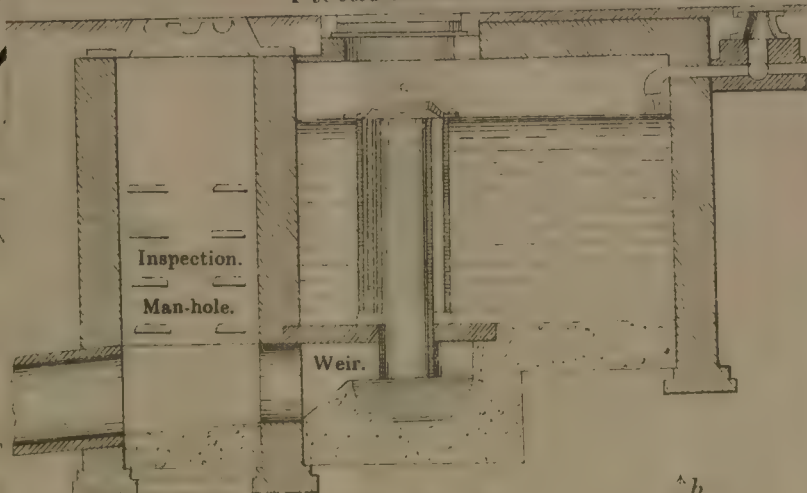


Fig. 4.

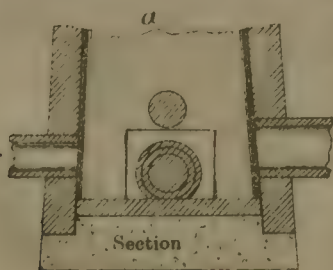
Fields Automatic Flushing Chamber.



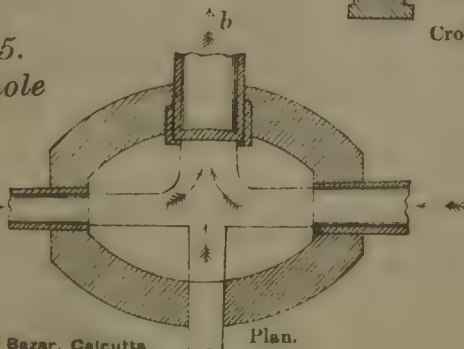
Cross Section.

Fig. 5.

Man-hole



Section



Plan.

gallons,—when, without further intervention, the entire volume of water is liberated at a regulated speed to flush the pipes. The tank after each discharge fills again and repeats the flushing operation. Smaller tanks, on this principle receiving their supply from the water mains, will also be used for flushing public urinals at regulated intervals.

On examining the sections it will be noticed, that at the starting of each line of street pipes, the gradient is greater than lower down. This provision is necessary, as when the quantity of sewage is small, the fall must be greater to produce the necessary velocity for keeping the pipes clear of deposit.

The sizes provided for the cross lines of pipes between the sewers are such as will admit of the flow of sewage by alternate lines, so that when any one sewer becomes obstructed another would still furnish an outlet and obviate the ill-effects of a stoppage, as much as is possible.

It is proposed to use glazed stoneware pipes throughout, of Doulton's or other approved manufacture. The rates in the estimates are those furnished by Messrs. Richardson and Cruddas, of Bombay, for English manufactured pipes. In a trial consignment from Messrs. Burn and Co.'s Raneegunge Pottery Works, Calcutta, it was found that the breakages amounted to 6 per cent.; and therefore English pipes, are estimated for, though the prices are slightly higher than for those of Indian manufacture.

The sizes of pipes provided in the proposed scheme may appear absurdly small to those who have not studied the subject, and the adaptability of glazed pipes for the entire system, from street-drain to main-drain, may also be doubted. I therefore quote the following from Sir Robert Rawlinson's address, already alluded to at the beginning of this report.

"House-drains in no case need exceed 4" in diameter, and for establishments containing 1,000 persons, a drain of 9 inches in diameter will be sufficient. In England, some towns having populations up to 10,000, have outlet sewers from 15 to 18 inches in diameter, and these sewers have in some instances been working during the last 30 years and have neither choked nor burst."

(To be continued.)

RAILWAY BREAKDOWN APPLIANCES.

IN Locomotive Engineering, with all the recent inventions, there still appears to be a wide field for further improvement, particularly with regard to "breakdowns," and every day teaches us new difficulties that have to be overcome in Railway disasters. Whether the subject is deemed too modest for a mechanical expert to gauge, we cannot say, but we believe that silence is due more to ignorance and neglect than any other cause. If one subject is more worthy of publicity, as illustrating the practical working of Railways, it is the one we have ventured to take up at present. Its importance is second to none, and no practical mechanic will ignore its value, but would rather encourage and develop a thoroughly efficient staff and train to relieve sudden Railway disasters which the best regulated Railways are liable to. To be in a state of readiness to meet the many forms of difficulty should be the chief duties of a Railway official, and consequently the appliances required should be ready, complete and effective. No Railway workshop is complete except it possesses an efficient staff with a breakdown train.

As there is always a difference of opinion in what constitutes a "breakdown train" with its necessary implements and appliances, it will be necessary to deal with the subject at some length from a practical point of view, and to add a few suggestions not ordinarily found in practice.

We are all aware that the nature of accidents on the different kinds of Railways are not alike in character. A light Railway working at a slow speed on plantations and mines if derailed, or otherwise injured, would require the simplest appliances to clear; not so in lines engaged in competition and running fast goods

and passenger trains, which, when in collision, intermix in indescribable confusion, and require a variety of resources, directed with skill and handled with rapidity. It is to this class of trains we now direct our attention. For handiness of transport and arrangement, a breakdown train should only consist of three vans, one 15-ton crane, and two platform waggons. The waggons should be placed on either side of the crane to act as crutch waggons. Each vehicle should be fitted with a powerful brake, that should be very reliable and joined by screw couplings of extra strength. The crane required should be of the multiple purchase system, giving an ample margin for strength. The crutch waggons on which the crane, jib and balance frame repose, should be strongly built platforms, fitted for the storage of about 500 cubic feet of wood packings of various sizes, and one of the waggons should be utilized for the carriage of a short powerful bogie lorry, strong enough to support one end of the heaviest engine in the event of a leading or trailing axle becoming derailed or disabled, and the lorry should be fitted with ring bolts on the sides to allow of speedy slinging. Iron lockers should also be fitted on the platform of the two waggons for the storage of lighting material, lamps and fishplates, iron packings for axle boxes, and other miscellaneous stores that may be required. Two pieces of reversible rail 18 to 20 feet, at least 75lbs. to the yard, should be placed lengthways clear of wood packing to be used for sliding engines or tenders, when a distance from the road.

The first van should be divided into two compartments, one larger than the other; the smaller compartment should be made large enough to accommodate the officials. The seats should form lockers for the stowing of special clothing, &c., and a desk should occupy one corner to contain writing materials and for the purpose of communication. The larger apartment should contain a stove and be fitted with a brake and longitudinal settees, the under portions of which to form lockers and a small camp table for the convenience of the men. The end of the van should be fitted with four shelves three feet from the floor level, under which is stored the head lamps—first shelf to contain two or three dozens detonator signals, a few flags, one guard's bag, and three leather buckets; second shelf to contain hand lamps for use of the officials, one roll of trimming and a can of oil and spare sheets; third cupboard amongst other articles should contain a complete box of surgical instruments, dressing cloth, lint and supply of splints for broken limbs; the fourth cupboard to complete the list should be furnished with cans, pints, drinking mugs, a supply of coffee, tea and sugar, also spirits and wines; and lastly a few folded ambulance litters should be stowed in one of the lockers.

The second van should be fitted up as a workshop, containing an 8-inch vice, mounted on a fixed bench, and must be rendered portable, a judicious selection of files, hammers, chisels of various sizes and lengths, to be neatly arranged on the sloping bottom of the wooden lockers, which should also be arranged to hold a supply of round and square hand punches, absolutely necessary for cutting away bolts and punching them out. All the lockers should have the contents marked upon them in large white letters, so that they may be distinctly visible at night with the aid of hand lamps. This travelling workshop should also contain spare leather, valves and handles for hydraulic lifting tackle, and any other duplicate part needed to repair broken appliances, all neatly placed and conveniently handy. The remaining range of lockers to be so divided as to give separate room for the various miscellaneous articles needed, viz., bolts and nuts, a dozen stout chisel bars, always kept sharp, two hammers of different sizes, two complete sets of spanners, arranged symmetrically in leather loops, each loop stamped with size of spanner, and four adjusting spanners of sizes. Some of the lockers should be fitted with smaller divisions and should contain slip pins of sizes, a variety of split cotters, solid taper pins, a piece of rubber insertion, a ball of spun

yarn, two balls of marling, one coil of copper and one of iron wire, a large and varied assortment of hard wood wedges neatly packed, and about four dozens slabs of hard wood varying from $\frac{1}{2}$ inch to 1 inch thick and 4 to 8 inches in length by 4 inches in breadth. All iron and steel working tools should be kept distinctly separate from wood-working tools, all of which should be securely fitted into leather loops and ledges. There should also be two double-handed axes of sizes, two hand-saws, four augurs from $\frac{1}{2}$ to 2 inches in diameter, two gouge and four wood chisels, with iron handles, an adze, mallet and an assortment of nails and screws, a couple of screw drivers and a brace with bits. One of the lockers should also contain one dozen steel jack bars, a few spiked and clawbars, six steel jemmies, three screw cramps and four clips for broken springs. One compartment of this locker should be reserved for appliances and gearing for dealing with broken axles, and should comprise three strong clips of different sizes bolts and bands, two powerful screw twitches, and four wood packings to go between the slide bars, so as to secure the pistons when uncoupled. On the outside of the locker should be fixed one wheel gauge, and lastly two spades, two shovels and four picks should be placed where conveniently handy.

The third van should be strongly built, and instead of cupboards and lockers, two rows of strong hooks should be fitted on the half of two sides of the van. The upper row should be well coiled with special ropes fastened with lashings, that can be easily undone, so as to prevent tangling. The bottom row to be similarly arranged for the reception of rope slings and chains. The other half of the vehicle should be so arranged as to securely hold four 5-ton windlass jacks, light and compactly made of cast steel, and capable of being carried by one man; these jacks are very useful for shifting and lifting carriages and waggons in any position, with or without wheels; they should be flanked at either end by one 10-ton windlass jack, suitable for lifting one end of the heaviest carriage, and for relieving and assisting hydraulic jacks as occasion requires. Further, four 10-ton hydraulic jacks two feet high with handles placed alongside, and one hydraulic jack on traverse frame, capable of lifting 20 tons if required: all these should be securely bracketed to walls of van. On the other side of same half of van, should be strapped two bottle jacks 2ft. 4in. in height, suitable for heaviest weight if required; alongside of which should be ranged six more bottle jacks, varying from 2 feet to 12 inches in height, placed in upright position in the same quadrangular space and held in position by strips of leather. There should also be two travelling jacks one of 12 and the other of 10 tons. These tracers are very handy when locomotives are removed over very bad ground to any distance, or when the engine or tender be placed in a critical position, unsafe for use of hydraulics. Above these should be triced two 30ft. 6-inch hauling ropes, one set of 10-inch pulley blocks, with 5-inch rope; this is required for slewing and hauling by hand. Between the pulley blocks and hauling ropes, a dozen strong slings varying in length should be placed. Chains and chain slings should be coiled on wooden studs on the floor of the van. The slings to consist of one 40ft., $1\frac{1}{2}$ in. diameter, hauling chain, armed with very strong hooks, one 30ft., $\frac{1}{2}$ in. diameter, and one 30ft., $\frac{3}{4}$ in. diameter. These with one extra chain for crane will be strong enough equipment for any ordinary Railway collision, or obstruction. Twelve sling chains varying from 1 to $\frac{3}{4}$ inch in diameter, the ends to be made to reeve through the other, two strongly made coupling hooks with a link in the middle, and a hook at each end for close coupling of heavy vehicles when ramping, two spare engine couplings and four for waggons, four screw couplings for carriages; four screw twitches of different lengths will be invaluable for pulling and holding together the disorganised portions of trains or material, to enable them to travel; four cast steel light single ramps (right and left) suitable for empty waggons and light carriages, four heavier ones for loaded waggons. All to be neatly

arranged on floor of waggon. Two 10 feet ladders required to climb to the top of waggons when piled on each other, should be lashed to the roof of van; six shackles of sizes to be ranged on end of van, with one 10-inch and one 8-inch iron snatch blocks fitted with special shackles of sizes to be placed at one end; this is essential for clipping rails and sleepers; also four special screw clips for grappling loco. or carriage bogies to under frames when lifting; one stove in centre of van for heating purposes, and two special wooden blocks to be used when axle guards are carried away.

If space permitted, it would only be reasonable that we should enter at some length on the various methods of dealing with special difficulties to illustrate the efficiency and application of the means already enumerated; but these can only have but a general value, as nearly every accident possesses peculiar features requiring special treatment, and such special treatment proves the necessity of replete means, and a good working staff.

H. T.

NOTES FROM HOME.

(From our own Correspondent.)

THE London and Brighton Railway has commenced to-day to run a Pullman car train to Newhaven for the convenience of their increasing traffic to the continent through this port.

The London and North-Western Railway Company and the Caledonian Railway Company have announced that beginning to-day the express leaving Easton at 10 A.M. will be accelerated to arrive at Glasgow and Edinburgh at 7 P.M. instead of 8 P.M. The journey will thus be performed in nine hours instead of 10, or an average speed throughout the whole distance of 44.62 miles per hour, allowing nothing for stoppages. It is stated that no sooner was this acceleration of speed by the North-Western announced than the Great Northern took up the gauntlet, and now the east is to beat the west by half an hour.

Against this it is curious to read an announcement that it is proposed to increase the average rate of speed of mail trains in Russia from 20 miles an hour, including stoppages, to 23 miles per hour, and the Ministry of Railways is at present engaged in considering this mighty question. It is also stated that on some Russian lines the average rate of speed is 10 and 12 miles per hour. The fastest train in Russia is the courier train between St. Petersburg and Moscow, which travels at the rate of about 28 miles per hour.

The Holyhead Local Board have resolved to petition the Government, with a view of inducing it to undertake the removal of the Platter Rocks at the mouth of the Holyhead Harbour. It is estimated that the cost of removing them would be about £250,000. If this can be achieved Holyhead harbour would be one of the most accessible and protected harbours in the country.

Engineer gave an illustrated description of the ten-ton breakdown travelling cranes intended for use on the 5ft. 6in. gauge of the Indian State Railways of North-Western India. These cranes are suited to lift and slew a weight of ten tons at a maximum radius of 16 feet from centre of the pillar to the centre of the chain, and are to have a maximum height at work of 19 feet 8 inches from rail level to the centre of the sheave at the jib head, with a loose link motion for lowering the jib, which is of wrought-iron.

The Association of Municipal Engineers, at the invitation of the Mayor, paid a visit to Leamington last week, and the meeting was largely attended. The Borough Engineer, Mr. De Normanville, read a paper on the Water-Supply of Leamington, in which he stated that down to 1878 the water-supply of the town was derived from the River Leam, which became polluted, when it was decided to sink an artesian well upon the advice of Sir Andrew Ramsay, the late Director-General of Geological Survey. The author fully described these wells. Some interesting figures were given in the paper of economy in the use of the water. Instead of using the town water-supply for watering the streets, special means were adopted for pumping up the river water for that purpose, thereby effecting a saving of $1\frac{1}{4}$ million gallons per month. A further saving of $4\frac{1}{4}$ million gallons per month is obtained by the detection and prevention of waste in the use

of Deacon's waste meter, the excellent results of which were spoken off in the highest terms, and its application described by the author of the paper. The discussion which followed shewed that most of the speakers advocated the use of adits to effect an increase in the yield of the wells as against the deeper sinking as advocated by the Surveyor. The members visited the water-works and an inspection was made of the machinery and arrangements for pumping water from the river for street watering purposes.

At the general meeting of the Institution of Civil Engineers, Mr. George Barclay Bruce was re-elected President. Sir John Cooke, Mr. G. Berkeley, Mr. Harrison Hayter, and Mr. Alfred Giles, M.P., were elected Vice-Presidents. Other members of Council were elected: Messrs. W. Anderson, B. Baker, J. W. Barry, Sir H. Bessemer, E. A. Cowper, Sir Jas. Douglass, Sir Douglas Fox, C. Hawkesley, Jas. Mansergh, W. H. Preece, Sir Robert Rawlinson, E. J. Read, W. Shelford, F. C. Stileman and Sir W. Thomson. The usual President's *soirée* will not be held this year.

In an illustrated account of the maxim gun, given in *Engineer*, it is stated that over-heating is prevented in this weapon by the water jacket. It has been found that water begins to boil after 600 rounds have been fired and subsequently nearly $1\frac{1}{2}$ pints or about 2lbs. of water are evaporated for every 1,000 rounds. The water is in contact with the actual barrel for about two-thirds of its length, being automatically admitted from a small cistern into the barrel casing by the recoil of the barrel and escaping as steam at the end of the tube near the muzzle of the gun.

The Italian Exhibition, now being held in London, has several features of peculiar interest. The Government of Italy, proud of possessing the next best navy in the world to our own, has sent a very complete exhibit including a set of models of the principal ships in the Italian Navy. Italian milling machinery, the excellence of which is probably second to none in Europe, may here be seen in full work. A striking exhibit is the art metal work, which is much superior to anything we have in England. The Exhibition buildings themselves, which were used last year for the American Exhibition, are supported by pillars formed of old rails rivetted together. In the gardens is an ingenious reproduction of the celebrated grotto of Capri. The stalactites are illuminated with electric light. The floor is lined with sheet iron painted blue, over which a quantity of water is flooded to produce the effect of the sea rolling into the grotto from the Bay of Naples. To make the illusion complete a Blackman air propeller is secreted and raises little waves. A panorama of Vesuvius makes the illusion perfect. The electric lighting of the Exhibition is entirely on the Thomson-Houston system. There are upwards of 300 arc lamps used in lighting the buildings. This system, though only brought out four years ago, is said to be carrying everything before it.

BURMA.

(From our own Correspondent.)

A RIVAL Telephone Company has obtained sanction from the local Government to open out a new line in opposition to the Oriental Telephone Company. Whether there is a profitable field at present in this Province for a second undertaking of this kind is an open question. The pioneers have had it their own way, and consequently monopolised the principal centres, and Government too, and unless the new Company intend to compete by considerably reducing their charges, we fear that their financial results will be anything but remunerative.

Since the opening of the Rangoon College, the Educational Syndicate intend to establish, in conjunction with the College, a Technical School for the training of indigenous youths; instead of sending them to India as heretofore. Drs. Forshammer and Romanis, the present Professors, have been retained, and two special teachers will be selected at Home by the Director of Public Instruction, now on furlough. These will comprise the staff, and the school will be under the direct control of the Syndicate. This system of control has been objected to by many members of the Corporation; and it is now advocated that the Institution should be a Government one, entirely under Government control, and not under Corporate bodies, the same as was originally established in England, when the Government School of Design and the Government School of Mines was first started, and as it is at present in the vastly improved institutions that have sprung

from these; and that now exist in South Kensington, as the Normal School of Arts and the great Technological Training College of the City and Guilds of London Institute. These institutions did not come into existence till Government had set the example, and in this Province, where there are no Corporations with special funds, and where private enterprise seldom leads, and where the conditions are in so many respects different, it is therefore absolutely necessary that Government should give the lead—just as in the case of ordinary education. Government colleges and schools were necessary to create a demand for sound education, and to serve as incentives and models for the establishment of private institutions, and to create a supply of teachers in the same manner as regards scientific and technical education.

The local Government are now moving in the matter for the better carrying out of the provisions under the Boiler Inspections Act, so as to secure the safe and efficient conduct of the steam engines at work in the different steamers and launches plying in the waters of this Province. It has been found on recent examination that the boilers and pipes of these vessels gradually become encrusted with mud, by using the water of the river, thereby decreasing the steaming power of the vessels and otherwise endangering it. A special contrivance has now been invented to filter the water as it is being pumped into the boilers, also a searching examination made before each vessel leaves the port.

The sooner our new drainage scheme is completed by Messrs. Shone and Ault, then only can we expect the sanitary improvement of the town. In some of the recent reclaimed lands, the newly cut drains have been treated after the manner of canals, that is, by using the ordinary method of cleaning out drains, by digging out the silt and throwing it upon either side, thereby producing results far from favorable to the inhabitants of the vicinity, or those who have occasion to pass by. To begin with, a *kutchra* drain is scarcely a recognised feature in modern sanitation, and a Municipality can scarcely be said to be discharging its duty to the community, whose sanitary interests are entrusted to its care, when it makes no better provision for the removal of sewage than by cutting several ditches through the heart of a populous town, and allowing the filth to stagnate in them, more so in the monsoons, when the dried filth forming the banks is washed in, and allowed to mix again with the fresh filth, rendering the neighbourhood truly pestilential.

In connection with the general scheme of marine defences, I reported some time back that the Supreme Government had stopped further progress for want of funds; the work has now again been taken into hand and almost completed. One hundred cast-iron gun cotton mines have been recently imported from Woolich and secured in the channel of the river.

We hear that through the agitation made by Mr. Holt Hallett at Home, several of the English Chambers of Commerce, in conjunction with several of the leading merchants of this City, are now urging upon the Secretary of State for India the necessity of opening out the proposed line of Railway, as advocated by that gentleman as the only means of opening out new markets for English goods; in fact, a syndicate with the required capital has already been formed, and is now only awaiting Government guarantee.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, June 16, 1888.

Upper Burma.

Mr C. A. B. Target, Executive Engineer, 1st grade, made over, and Mr. W. G. Newton, Executive Engineer, 3rd grade, assumed temporary charge of the Kyaukse Division, in addition to his own duties, on the afternoon of the 5th instant.

Lower Burma.

Mr. H. F. White is appointed as Superintending Engineer, 1st circle (Rangoon), Mr. A. B. Gatherer as Superintending Engineer, 2nd circle (Thayetmyo) and Mr. H. J. Richard as Officiating Superintending Engineer, 3rd circle (Mandalay).

Mr. R. S. Strachey, Assistant Engineer, 1st grade, Toungoo-Mandalay Extension, Burma State Railway, was granted privilege leave from the 29th February to the 17th March 1888, both days inclusive.

Leave on medical certificate is granted to Mr. E. C. Elliot, Executive Engineer, 4th grade, temporary rank, Toungoo-Mandalay Extension, Burma State Railway, for a period of six months, from the 21st June 1888, together with the usual subsidiary leave.

Madras, June 19, 1888.

The following promotions and reversions are ordered :—

Colonel H. M. Vibart, R.E., from Superintending Engineer, 2nd class, to Superintending Engineer, 1st class, permanent rank, with effect from 8th June 1888.

Lieutenant-Colonel C. Bowen, R.E., from Superintending Engineer, 3rd class, to Superintending Engineer, 2nd class, permanent rank, with effect from 8th June 1888.

Mr. G. T. Walch, from Superintending Engineer, 3rd class, to Superintending Engineer, 2nd class, sub *pro tem.*, with effect from 8th June 1888.

Major R. R. E. Drake-Brockman, R.E., from Executive Engineer, 1st grade, to Superintending Engineer, 3rd class, sub. *pro tem.*, with effect from date of assumption of charge of 4th Circle.

Mr. J. D. Grant, from Executive Engineer, 2nd grade, to Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 8th June 1888.

Captain W. L. C. Baddeley, R.E., from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 8th June 1888.

Mr. J. E. Paul, from Executive Engineer, 4th grade, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 24th May 1888.

Mr. A. A. G. Malet, from Executive Engineer, 4th grade, temporary rank to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 24th May 1888.

Mr. A. M. Hayes, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 24th May 1888.

Mr. J. J. Whiteley, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, permanent rank, with effect from 29th May 1888.

Mr. J. W. Martin, Executive Engineer, 1st grade, sub. *pro tem.*, to officiate as Superintending Engineer, 4th Circle, from 8th June 1888, and pending the return of Major R. R. E. Drake-Brockman, R.E., from furlough.

Mr. J. Inglis, Assistant Engineer, 1st grade, is granted furlough on medical certificate for one month from 3rd June 1888.

Punjab, June 21, 1888.

His Honor the Lieutenant-Governor is pleased to sanction the following temporary promotions and reversions in the amalgamated Engineer Establishment of the General and Irrigation Branches of the Public Works Department, Punjab, with effect from the dates specified against each :—

Rai Kanhya Lal Sahib, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, *vice* Mr. Hicks, reverted from sub. *pro tem.* 4th grade Executive Engineer, with effect from 30th October 1887.

Rai Kanhya Lal Sahib, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Hicks, to sub. *pro tem.* 4th grade Executive Engineer, with effect from 6th November 1887.

Rai Jagdish Rai Sahib, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. E. G. Fraser, to sub. *pro tem.* 4th grade Executive Engineer, with effect from 6th November, 1887.

Rai Jagdish Rai Sahib, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, *vice* Captain Abbott, R.E., returned from furlough, with effect from 9th November 1887.

Rai Jagdish Rai Sahib, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. F. E. Rose, proceeded on furlough, with effect from 27th November 1887.

Rai Jagdish Rai Sahib, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, *vice* Mr. Sadler, returned from furlough, with effect from 12th December 1887.

Rai Kanhya Lal Sahib, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, *vice* Mr. Harrington, returned from furlough, with effect from 19th December 1887.

Rai Tulsi Ram Sahib, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 24th December 1887.

Rai Kanhya Lal Sahib, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Rai Tulsi Ram Sahib, reverted, with effect from 24th December 1887.

Rai Kanhya Lal Sahib, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, on Mr. Harris's return from furlough, with effect from 7th January 1888.

Mr. F. Harris, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Rai Kanhya Lal Sahib, reverted, with effect from 7th January 1888.

Mr. R. B. Yates, from Assistant Engineer, 1st grade to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Tufnell, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 19th March 1888.

Mr. R. B. Yates, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, *vice* Mr. Hatten, returned from furlough, with effect from 26th March 1888.

Mr. R. B. Yates, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Barratt, proceeded on furlough, with effect from 27th March 1888.

Rai Kanhya Lal Sahib, from Assistant Engineer, 1st grade,

to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Granville, proceeded on furlough, with effect from 1st April 1888.

Rai Kanhya Lal Sahib, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, *vice* Mr. Learmonth, whose services are replaced at the disposal of the Punjab Government, with effect from 1st April 1888.

Rai Kanhya Lal Sahib, from Assistant Engineer, 1st grade, promoted to Executive Engineer, 4th grade, temporary rank, *vice* Mr. W. Smith, proceeded on furlough, with effect from 2nd April 1888.

Rai Jagdish Rai Sahib, from Assistant Engineer, 1st grade, promoted to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Learmonth, proceeded on furlough, with effect from 5th April 1888.

Mr. J. R. E. Verschoyle, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Maclean, proceeded on furlough, with effect from 15th April 1888.

Mr. W. E. F. Handcock, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Bird, proceeded on furlough, with effect from 10th April 1888.

This cancels Notification dated 7th March 1888, and Notification dated 28th March 1888.

Irrigation Branch.

Mr. C. E. Day, Executive Engineer, 3rd grade, from the Hansi Division, Western Jumna Canal, which he left on the forenoon of the 25th February 1888, to the Karnal Division, Western Jumna Canal, which he joined on the forenoon of the same date.

Mr. F. C. Rose, Assistant Engineer, 2nd grade, from the Chenab Canal Division, which he left on the forenoon of the 13th May 1888, to the 2nd Division, Bari Doab Canal, which he joined on the forenoon of the 16th idem.

The following transfers have been made :—

Mr. F. Harris, Executive Engineer, 4th grade, (temporary rank), from the Chenab Canal Division, which he left on the forenoon of the 20th May 1888, to the 2nd Division, Bari Doab Canal, which he joined on the forenoon of the same day.

Mr. W. J. Greer, Executive Engineer, 3rd grade, sub. *pro tem.*, from the 2nd Division, Bari Doab Canal, which he left on the afternoon of the 21st May 1888, to the office of Superintending Engineer, Bari Doab Circle, which he joined on the forenoon of the 22nd idem, for employment on special duty.

With reference to Punjab Government, Irrigation Branch, Notification dated 12th May 1888, Mr. T. R. G. Ward, Assistant Engineer, 1st grade, landed in India on return from the leave therein granted on the afternoon of the 22nd April 1888, and was posted to the office of Superintendent of Works, Western Jumna Canal, which he joined on the forenoon of the 26th idem.

India, June 23, 1888.

Mr. J. G. H. Glass, Executive Engineer, 1st grade, is appointed Superintending Engineer and Secretary to the Chief Commissioner, Central Provinces, in the Public Works Department.

The services of Mr. C. A. B. Target, Executive Engineer, 1st grade, Burma, are temporarily placed at the disposal of the Government of Madras.

N.-W. P. and Oudh, June 23, 1888.**Irrigation Branch.**

Mr. A. Grant, Executive Engineer, 1st grade, Personal Assistant to Chief Engineer and Under-Secretary to Government, Public Works Department, Irrigation Branch, is granted fifteen months' furlough out of India, with effect from the 1st July 1888, or subsequent date.

Mr. W. J. Wilson, Executive Engineer, 2nd grade, sub. *pro tem.*, Narora Division, Lower Ganges Canal, is appointed Personal Assistant to the Chief Engineer and Under-Secretary to Government in the Public Works Department, Irrigation Branch, *vice* Mr. A. Grant, proceeding on furlough.

Mr. H. G. Boyce, Executive Engineer, 4th grade, sub. *pro tem.*, Eastern Jumna Canal, is transferred from the 3rd to the 2nd Circle of Superintendence and appointed temporarily to the charge of the Narora Division, Lower Ganges Canal.

Mr. J. H. A. Ivans, Executive Engineer, 4th grade, sub. *pro tem.*, is temporarily transferred from the 1st to 3rd Circle of Superintendence.

Mr. G. T. Barlow, Assistant Engineer, 2nd grade, Aligarh Division, Ganges Canal, passed the colloquial examination in Hindustani on the 9th June 1888.

Central Provinces, June 23, 1888.

Mr. H. L. Cleaver, Assistant Engineer, temporarily attached to the Katni-Umaria Section of the Bilaspur-Etawah State Railway, is transferred to the Jubbulpore Division. Mr. Cleaver joined the Jubbulpore Division on the forenoon of the 22nd ultimo.

With reference to Notification, dated 4th current, Mr. C. O. Leefe, Executive Engineer, was relieved of his duties in the Nagpur Division, on the afternoon of the 8th idem.

With reference to Notification, dated 4th current, Mr. R. B. Thomson, Executive Engineer, Jubbulpore Division, availed himself of the privilege leave granted to him, making over charge of his duties to Mr. C. O. Leefe, Executive Engineer, on the afternoon of the 15th idem.

Assam, June, 23, 1888.

Rai Preonath Banerji, Bahadur, Executive-Engineer, 3rd grade, and District Engineer, Sylhet, who was granted privilege leave for two months and fifteen days in orders dated the 26th April 1888, reported his return to duty on the afternoon of the 16th June 1888, and resumed charge of his office from Matadin Sukul, Rao Sahib, M.A., Assistant Engineer, on the afternoon of the same day. The unexpired portion of his leave is hereby cancelled.

Bengal, June 27, 1888.*Establishment—General.*

Mr. H. H. Green, Assistant Engineer, having been recalled to duty on the 5th January last, the unexpired portion of the three months' Language leave granted by the Agent to the Governor-General in Beluchistan, Public Works Department, is hereby cancelled.

Mr. G. A. D. Anley, Superintending Engineer, Eastern Circle, is granted furlough for three months and thirty days, with effect from the 17th July next.

The Lieutenant-Governor is pleased to make the following promotions in the Engineer Establishment, with effect from the date specified:—

Mr. A. S. Thomson, (on furlough) from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, sub *pro tem.*, with effect from 22nd May 1888.

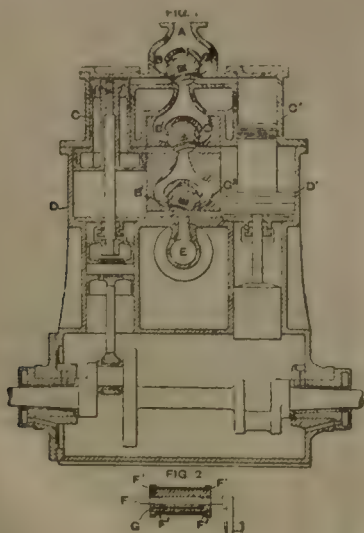
Rai Haran Chunder Banerjee Sahib, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 22nd May 1888.

Establishment—Irrigation.

Mr. H. F. B. Frost, Executive Engineer, 4th grade, temporary rank, attached to the Gunduck Division, is appointed to hold charge of the Eastern Sone Division as a temporary measure.

Indian Engineering Patent Register.**RECENT BRITISH PATENTS.**

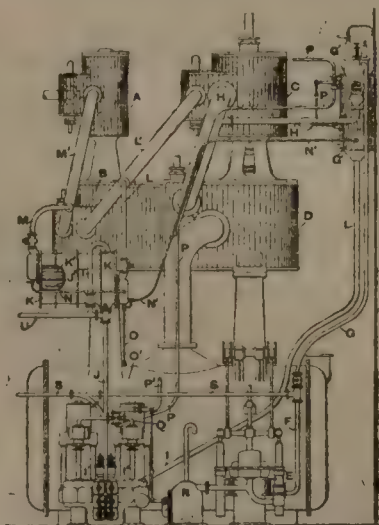
SLIDE VALVE—A. G. Browns, Cathcart, North Britain.—The valve here described is adapted for use in multiple cylinder single acting engines, and is substantially of cylindrical outline, but is cut away at certain points, so that the section resembles a Maltese cross. The motion of the valve is reciprocating, and its travel extends through less than one quarter of a revolution. The method of working will be understood by reference to *fig. 1*, which represents a section of the valves when employed in a four cylinder engine. *fig. 2* shews detached a longitudinal view of one of the valves. Steam is admitted into the steam chest A on both sides of the valve B. The steam passes through a recess on one side of the valve to the port of the cylinder C, and also through the auxiliary groove G. While steam is being thus admitted, the exhaust from the second cylinder C¹ is open, and the discharge takes place through the recess between the bearing surface of valves B B¹ to the top of the cylinder D. The exhaust from beneath the cylinder D is open through the recess in B¹ to the final exhaust E, while the exhaust from the top of the piston



in the cylinder D¹ is open through the valves B¹ B² to the bottom of the same cylinder. It will thus be seen that while pressure is being exerted upon the top of the pistons in the cylinders, the final exhaust, if connected with a condenser, is pulling in the same direction from beneath the lower pressure piston. When the valve motion is reversed, the steam inlet to the cylinder C is closed, and just before the inlet to the cylinder C¹ is opened, the supplemental passage G opens communication momentarily between the two cylinders C and C¹; the expanded steam from the first cylinder thus exhausts partially into the second cylinder, just before the full steam pressure is admitted. The further movement of the valve B closes communication between the cylinder C C¹, and opens the latter to full steam pressure; the former completes its exhaust through the valve B¹ to the top of the cylinder D¹, and the final exhaust from beneath the piston in the cylinder D¹ is at the same moment opened through B¹ to E, while the exhaust

from the top to the bottom of the cylinder D is opened through the valves B¹ B². The passages G¹ G² open communication momentarily between the cylinders D D¹ in the same manner as the passage G. The stems F are journalled at each end and are carried in bearings, with the object of holding the valve centrally in its seat and of decreasing the wear. Any ordinary means may be employed for operating the valves; and for the purpose of balancing with regard to exhaust, communication is made between the bottom and top recesses of the valve. This may be done conveniently by the passages F I shewn in *fig. 2*. Three claims are made for the form of the valve, and for the supplemental passage.—No. 5134. 6th April 1887.

FEED WATER HEATER.—J. Weir & G. Weir, Glasgow.—The object of this invention is to economise fuel by heating the feed water by steam which has operated to a certain extent in the engines, but which is applied for that purpose before its final exhaust. The accompanying figure illustrates the application of this invention to a quadruple expansion screw propeller engine. The feed water is first pumped by the engine E, and is delivered at a moderate pressure through the pipes F G into a feed heater G¹, in which the water is brought into immediate contact with the steam. The steam for this purpose is supplied through a pipe H, which is connected to the exhaust pipe H¹ of the third cylinder C. The partly heated feed water passes from G through a pipe I to a set of donkey pumps I¹, which supply the requisite pressure to the water to enable it to enter the boiler. The pipe J conducts the water to one compartment J¹ of a feed heater casing K, which is composed of the two compartments J¹ K¹. These compartments are surface feed heaters, and the steam which heats the water acts inside a tubular apparatus. The steam in the lower compartment is supplied by a pipe L, connected with the exhaust pipe L¹ of the second stage cylinder B; the steam in the upper compartment



is supplied by a pipe M, connected with the exhaust pipe M¹ of the pressure cylinder A. The water of condensation in the tubes of the high temperature surface heater K¹ is led by a pipe N into the steam inlet compartment of the next lower temperature feed heater J¹. The water will here impart its heat to the feed water, which is at a lower temperature than the water of condensation. In a similar way the water proceeding from the heater J¹ is led by the pipe N¹ into the lowest temperature feed heater G¹. If found preferable the water may be led by a pipe O directly to the main condenser O¹. Several automatic regulating devices are used in different parts of the engine. The steam to work the donkey pumps I¹ is supplied by a pipe P, which has a regulating valve controlled by a float within the feed heater G¹; or the steam to I¹ may be supplied by the pipe P¹, which is provided with a regulating valve Q, worked by a float in the hot well R. The feed water may be pumped from the main engine pumps E directly to the boilers through the pipe S connected to the delivery pipes of these pumps. When the feed water passes through all the heating apparatus, it proceeds to the boiler from the compartment K¹ through the pipes T U. The latter pipe is also connected to the donkey pump delivery pipe J. The inventors make three claims for the arrangements for heating the feed water for the boilers at successive stages with portions of steam which have worked to different extents, the feed water being pumped to its highest pressure before passing through the highest heating stages.—No. 6190. 28th April 1887.

Advertisements.**WANTED.**

A COMPETENT SURVEYOR for one year. Salary Rs. 40. Apply to the undersigned, with Copies of Testimonials.

GEORGE DALE,

Chairman, Municipal Board,

MIRZAPUR MUNICIPAL OFFICE,)
The 21st June 1888.)

MIRZAPUR.

REQUIRED.

FOR the Shikarpur (Sind) Municipality, a **SECRETARY**.

Knowledge of Engineering indispensable.

None but Europeans, Eurasians or Parsis need apply. Salary, Rs. 300, rising by annual increments of Rs. 25 to Rs. 400.

Applications, stating age and qualifications, to be made to the President not later than the 15th July.

C. S. STEEL,

PRESIDENT,

(148)

Shikarpur Municipality.

WANTED.

AN Overseer for the District Board, Patna, for 18 months certain, @ Rs. 90 per mensem, including allowances.

Applications with copies of Testimonials should reach this office not later than the 15th July 1888. None need apply who has not had experience of road and bridge works, and had not served in the P. W. D. as a 3rd grade overseer for more than five years.

By Order,

POORNA CHUNDR CHATTERJEE,

ACCOUNTANT,

For Offg. District Engineer,

Patna.

(146)

NOTICE.

WANTED, a **SECRETARY** for the Municipal Board of Sholapur. Candidates are invited to send applications, specifying full Name and Age, to Undersigned, before 20th of July next. Examination Certificates and Testimonials should accompany. Good knowledge of English and Marathi and, if possible, knowledge of Accounts, capacity for active and administrative duties, Professional Engineering, actual experience of Municipal or other administrative work, are the expected qualifications.

The permanent incumbent of the post is on leave without pay, which expires on the 1st of May, 1889, and is at present employed as Secretary to the Surat Municipality, and stands a fair chance of being confirmed there. The Municipality does not hereby bind itself to confer the vacancy upon the best or any of the candidates.

HIRACHUND NEMCHUND, Chairman,

SHOLAPUR MUNICIPAL OFFICE, }
21st June 1888. }

Managing Committee,
SHOLAPUR MUNICIPALITY.

WANTED

AN EXPERIENCED ESTIMATOR.

Apply with copies of testimonials and stating salary required, to—

THE STATE ENGINEER,

(143)

Bhavnagar.

NOTICE.

TENDERS for the carriage of building materials from Akra to Calcutta, for the year ending 31st August 1889, will be opened by the Superintendent of Works, Calcutta, at his office at 12 noon on Saturday the 7th July.

Form of tender and any further information may be obtained at the Office of Superintendent of Works.

G. F. E. S. NEILL, LIEUT.-COL., M. S. C.,
Superintendent of Works, Calcutta.

CALCUTTA; the 20th June 1888.

(145)

P. W. D. CHITTAGONG DIVISION.

Tenders are invited for Manufacturing and delivering the materials noted below. The Executive Engineer does not bind himself to accept the lowest or any tender

Name of work.	Tender to be in Form No.	Amount of earnest money to accompany each tender.	Date and hour of opening tenders.	Date of commencement of work.	Date of completion of work.	Deposit-money required to be paid by the successful tenderer.	REMARKS.
Manufacturing and delivering at Noakhally for Civil Buildings, 22 Lacs of Table Moulded and Pugged bricks. 50,000 c. ft. First Class Soorkey. 50,000 " of Brick Material for Concrete.	P. W. D. Form No. 14 M. (Supply of materials.)	Vide table on the form quoted above.	* 4th July 1888. (12 noon.)	Half before the 31st March 1889.	(1889) 31st July 1889.	10 per cent. on the total value of the supply.	Particulars and specification can be seen— At the Office of the Executive Engineer 1st Calcutta Division. At the Office of the Executive Engineer Dacca Division. At the Head Office of the Chittagong Division, Chittagong. Samples of materials required can be seen at Chittagong.

* "The tender will be opened on Monday the 9th July 1888 and not 4th July 1888."

CHITTAGONG;
The 1st June 1888.

F. SILLS, C. E.,
EXECUTIVE ENGINEER,

Chittagong Division.

COMMERCIAL UNION ASSURANCE CO., LD.

Extracts from the Twenty-sixth Annual Report viz. for the year 1887.

FIRE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£769,265 0 0
Interest ...	£ 19,612 0 0
Losses after deducting Re-insurances ...	£443,587 0 0

LIFE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£125,559 0 0
Interest and Dividends ...	£ 45,649 0 0
Claims less Re-insurances,	£ 79,229 0 0

MARINE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£175,118 0 0
Interest ...	£ 8,294 0 0
Losses after deducting Re-insurances ..	£138,365 0 0
Interest not belonging to above, but included in Profit and Loss ..	£ 18,545 0 0

The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording *absolute security* to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

C. H. OGBOURNE, Manager and Underwriter.

ICE! ICE!! ICE!!!

FOR SALE.

THREE Ammonia Machines, Carrés system, 2 of 1 ton each, 1 of $\frac{1}{2}$ ton capacity with Steam Engine, Boiler and Ammonia Still. The whole for cash. The above are second-hand having been at work 4 or 5 years. For further particulars apply to

P. C. RUBIE,

LUCKNOW ; } P.-ATTY. TO LIQUIDATORS,
16th June 1888. } General Ice Factory Co, Ltd.

(141)

CREAT WESTERN HOTEL, BOMBAY.

[29]

MACHINERY CYLINDER ENGINE OIL SPINDLE BATCHING LUBRICATING
Stocks of all descriptions always in hand. Contracts at reduced rates.
(134) KER DODS & Co., 81, Clive Street.

**E. T. C. BLEND
HIGHLAND WHISKY.**
Rs. 25 per dozen.

**GISBORNE & CO.,
40, STRAND.**

(87)

**THOMSON & MYLNE'S
PATENT SUGARCANE MILLS.**

For particulars of Depots, Licensees, &c., address—

THOMSON & MYLNE,

BEHEEA, E. I. RAILWAY;

or 6, Commercial Buildings, Calcutta.

(103)

A GREAT WANT SUPPLIED.

No Package Genuine
without this Trade
Mark.



Registered 14th October 1878.

CYLINDER OIL.

TURNER, MORRISON & Co., Calcutta,

Sole Agents for Bengal.

No Package Genuine
without this Trade
Mark.

(93)

JEYES' SANITARY COMPOUNDS

*Thirty-one Prize Medals and First-class Certificates
Gold Medal, International Exhibition, London, 1885.*

**Specially Appointed by the Royal Commission for the
Colonial and Indian Exhibition.**

Not a single case of illness occurred amongst the Native Artisans employed in the Exhibition owing to their Quarters being disinfected by

JEYES' SANITARY COMPOUNDS.

Supplied in various sized Packages to suit the convenience of Customers.

Full Directions for use supplied with every Package.

N.B.—One Gallon of Jeyes' Perfect Purifier Fluid makes one Hundred Gallons of Disinfectant.

DYCE NICOL & CO.,

SOLE AGENTS, Calcutta.

(142)

DRILLING MACHINE FOR SALE.

LYING at Rajmai Tea Estate, Sibsaigor, Assam, a new double gear Drilling Machine, 2 $\frac{1}{4}$ " Steel Spindle complete. A set of 22 Morse Twist Drills $\frac{1}{4}$ to 1 $\frac{1}{2}$ ". A set of 22 Common Twist Steel Drills. Cone for four speeds, also hand action. Lately imported, and is to be sold, as it is much too large for the Garden's work.

For further particulars apply to—

WILLIAMSON, MAGOR & Co.,

4, Mangoe Lane, CALCUTTA.

(137)

BEST MIRZAPUR STONE.

The Mirzapur Stone and Trading Co., Cut-Stone Contractors and Quarrymen Mirzapur, can supply—
Flagging Roofing.
Pillar Bases Coping.

And all descriptions of Cut-Stone. The cheapest in the market.
Apply to the Company or to

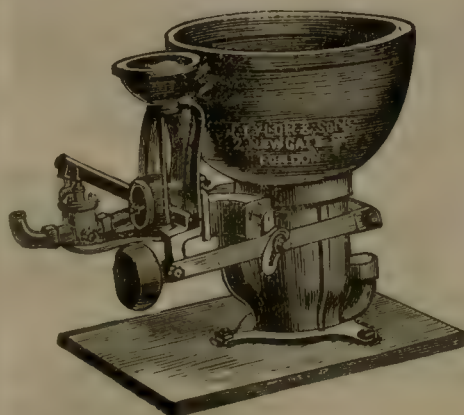
LYALL, MARSHALL & CO.,

4, Clive Ghat Street, CALCUTTA.

(109)

Depôt—Sulkea, Calcutta.

Calcutta Plumbing & Gas Fitting Establishment.



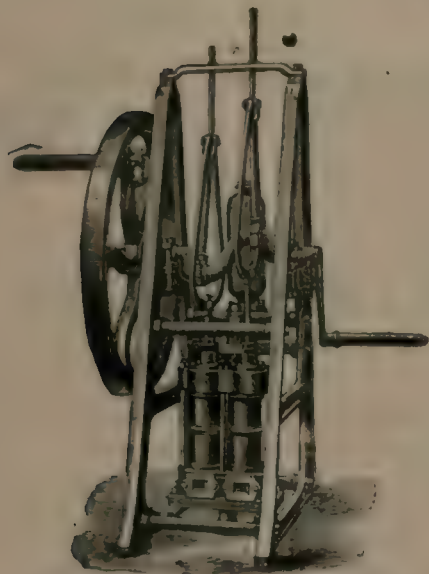
Materials of all sorts for the above always in stock. Trade supplied on the usual terms.

J. D. JONES,
*Mechanical Engineer,
PROPRIETOR.*

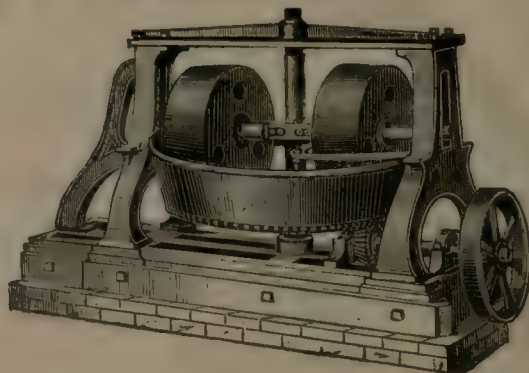
(108)

T. COSSER & CO., ENGINEERS AND FOUNDERS,

MCLEOD ROAD IRON WORKS AND METAL MART, KARACHI.



Improved Kite Motion Pumps.



Steam Mortar Mills with
innumerable improvements.
Guaranteed of exceptional
construction and design.

Undertake Engineering work in all its branches. Complete estimates and designs submitted for Bridges with Westwood and Baillie's patent Corrugated Floorplates. Being their Agents we can guarantee early delivery of complete bridges or materials for same. A large stock of Rolled Iron Beams of various sections. Section sheets with detailed information on application. Same printed on Vellum for Engineer's personal use.

Portland Cement of guaranteed quality in 400 lbs. casks (3,000 casks in stock.) Estimates and designs for Flour Mills, Cotton Presses, Ginning Factories with warehouses and offices attached with fireproof divisions and flooring. Largest Stock of Machinery, Tools and Plant and Tackle in general for Engineering purposes in Sind, Punjab and the N.-W. Provinces.

Portable Engines by Ruston, Proctor & Co., of various sizes and descriptions. Our RATES for these are perhaps the LOWEST in India.

Enquiries solicited for any article connected with Engineering, Civil and Mechanical.

A very large and miscellaneous stock of every possible requirement for Engineers.

(112)

IRON WIRE FENCING, SPECIALLY ADAPTED FOR INDIA AND THE COLONIES.

GEORGE'S PATENT TUBULAR IRON WIRE FENCING,

SPECIALLY DESIGNED FOR ENCLOSING RAILWAYS, ROADS, BUNGALOW GROUNDS, PLANTATIONS, &c.

Awarded Certificate of Merit Calcutta International Exhibition, 1883-84.

LARGELY used by the Indian State and Guaranteed Railways, combines Strength, Lightness, and Low Cost. Any smart native can erect it. Cost of transport per mile of Railway only about 3 annas per mile of Fence. Fencing Posts, Straining Posts, Galvanized Steel, Strand Wire, Galvanized Steel Barb Wire, Wrought-iron Gates of all sizes with Posts, complete, suitable for Railway Level Crossings, Plantations, Bungalow Grounds, &c. A complete Fence with Barb, Strand or Steel Wire, suitable for a plot of ground of any shape, or for a length of Road or Railway supplied ready for fixing.

Delivery given at any RAILWAY STATION in India.

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Stone's Patent Bronze.

Babbitt's Metal and Richard's Plastic Metal.

Regulus of Antimony, Pure Block Tin.

Pig and Sheet Lead, Muntz Metal Rods and Sheets.

Brass and Copper Rods, Tubes and Sheets.

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Best Tool and Miners' Steel.

Spring Steel selected, and mild Steel Sheets.

Lowmoor, Farnley, and best Staffordshire Bar and Sheet Iron.

Plain, Galvanized, and Corrugated Iron Sheets, Ridging and Gutterings.

Wrought Iron Tubes and Fittings for Gas and Water.

Lap-Welded Boiler Tubes.

Cast Iron Pipes with turned and bored spigot and socket joints and coated.

Rain Water Pipes and Connections.

High Conductivity Copper Tape Lightning Conductors.

Rolled Iron Joists and Girders.

